Annual Report

1979

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Issued by

Dr. E. G. SILAS

Director

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Compilation and Printing:

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Scientist S. 2.

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ANNUAL REPORT FOR 1979

DIRECTOR'S INTRODUCTION

During 1979 the Institute had undertaken 78 Research Projects/Problems under the existing five Divisions; 9 Inter-Divisional Projects; 4 Inter-Institutional Projects; 4 Demonstration Projects; 4 Sponsored Projects and 6 Training programmes. Good progress was maintained in all the on-going projects, new projects taken up during the year, in the Operational Research Projects at Kovalam and in the activities of the Krishi Vigyan Kendra, Narakkal.

The year has been a very significant one, being the Golden Jubilee year of the ICAR, and in the Lab-to Land Programmes organised by the Council as part of the celebrations, the Institute took early initiative to implement the programme at 6 selected centres in Kerala and Tamil Nadu. The proven low-cost technologies in mariculture developed by the Institute were taken up for transfer to 301 families which included fishermen, small and marginal farmers, landless labourers and Harijans. The exposure to the various techniques in intensive culture of prawns, finfishes, mussels, oysters and seaweeds through suitable training and demonstration programmes have created an intense awareness among the coastal rural population in and around the selected centres about the advantages in taking up coastal aquaculture on scientific lines.

On the capture fisheries side, the all India marine fish landings during the year were estimated at 1.39 million tonnes as against 1.40 million tonnes during 1978. This marginal reduction was brought about by the decline in the catches in all the maritime

States along the west coast except Maharashtra. However, the landings increased in all the maritime States along the east coast except West Bengal. Species wise, there were decline in the catches of oilsardine, mackerel and penaeid prawns. However, as compared to the previous year, increased landings were noticed in the case of lesser sardines, silverbellies, tunnies, seerfishes, carangids and catfishes.

Taking advantage of the delayed onset of the southwest monsoon the purse seine fishing in the Karnataka Coast was extended beyond May, landing appreciable quantities of oilsardine and mackerel. However, an unprecedented fire disaster at Malpe in the month of July brought about total destruction to 198 mechanised fishing boats which included 40 purse seiners, 140 trawlers and 18 sailing boats. The total loss was estimated at 2.3 crores of rupees. The Institute conducted an impact analysis of this incident and a detailed report was published in the Institute's *Marine Fisheries Information Service Technical and Extension Series No.* 5.

In experimental work, major breakthrough was achieved in the induced maturation, rematuration and subsequent spawning of the white prawn, *Penaeus indicus* by the technique of unilateral eyestalk ablation. This technique was also tried with success in the case of the crab, *Scylla serrata.*

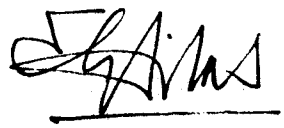
In finfish culture, experimental success has been achieved in the induced breeding of the mullet, *Liza parsia* with pituitary extracts along with human chorionic gonadotrophins. In the experiments conducted at Narakkal farm during October '79, viable eggs were obtained as a result of hypophysation and the eggs from one fish hatched out successfully yielding about 4500 larvae.

In the Operational Research Project at Kovalam, a special submerged raft has been designed and fabricated for mussel culture. Initial experiments have shown that this type of raft could successfully overcome the serious difficulties experienced in the operation of ordinary floating rafts in rough seas and cyclonic weather common in this area.

In the Sponsored Projects, one on the 'Assessment of Fry Resources of Cultivable Penaeid prawns in the Kerala and Karnataka Region', and the other on 'Elver resources survey and eel culture', good progress has been achieved during the year. The fry resource of *Penaeus indicus* were observed to be rich at centres such as Venkatapur, Aghanashini, Gangavali, Malpe and Mulki in Karnataka and at a number of centres in Kerala. Similarly a number of centres have been identified in Tamil Nadu for the collection of elvers and glass eels.

Pre-project work on the Centre of Advanced Studies in Mariculture sanctioned for the Institute commenced during the year and the Director who is also the Sub-Project Co-ordinator undertook a study tour of some to the institutions in Japan, U.S.A. and U.K. to identify expert consultants and Institutes for developing mutual collaboration for training the Faculty members.

The Institute has endeavoured during the year to carry the results and technologies developed in the laboratories closer to the actual end users through various training programmes, demonstration projects, education and extension activities. Detailed reports on the various projects and programmes are given in the ensuing chapters.



(E.G. Silas)
Director

Brief history, organisational set up and objectives:

The Central Marine Fisheries Research Institute was established in 1947 by the Ministry of Agriculture and Irrigation. It came under the control of ICAR in 1967. The head quarters of the Institute is at Cochin and it has a Regional Centre at Mandapam Camp, Tamil Nadu. Besides these, the Institute has established 11 Research Centres and 29 Field Centres on both the coasts. Field experimental stations are located at Narakkal, Kovalam, Tuticorin, Mandapam, Vizhinjam and Calicut.

The overall objectives of the Institute are to conduct short-term and long-term multidisciplinary researches on the marine capture and culture fisheries of the country in order to provide *Research* support for the rational exploitation, conservation and management of the marine and brackishwater resources for stepping up production from the coastal water areas and the Exclusive Economic Zone and *Development* support for growth with stability of the industrial, artisanal and culture fisheries through transfer of technology, dissemination of information and *education*, *training* and *extension*.

Implementation of the projects:

The various research projects/problems undertaken during the year 1979 were implemented by scientific and technical staff of the existing Divisions viz., Fishery Resources Assessment Division, Fishery Biology Division, Crustacean Fisheries Division, Molluscan Fisheries Division and Fishery Environment Management Division and the personnel engaged in the Inter-Divisional and Inter-Institutional projects, Demonstration projects, Operational Research project, Krishi Vigyan Kendra, Training Programmes and Lab-to Land Programmes.

Library Section:

During the year 1979 about 600 books, 2500 periodicals, and reports were added to the library at head-quarters and the expenditure involved was Rs. 2,50,000/-. Considerable number of books and reasonable number of periodicals were also added to the libraries of the Mandapam Regional Centre, Research Centres at Veraval, Bombay, Karwar, Goa, Mangalore, Calicut, Minicoy, Vizhinjam, Tuticorin, Madras, Kakinada and Waltair, at a cost of about Rs. 80,000/-.

CMFRI Special Publication No. 6, *"Proceedings of the first workshop and technology transfer in coastal aquaculture at Cochin and Mandapam"* and *Marine Fisheries Information Service—Technical and Extension Series* Nos. 5—13 were published in 1979.

Steps were taken during the last quarter of the year for organizing a "Special Reference Desk" containing books, periodicals, reprints and reports on the 'Taxonomy of the fishes of the Western Indian Ocean' for the ready use of the 40 scientists from various countries including our country, participating in the FAO/DANIDA Programme to be conducted in our Institute between 21st January and 15th February 1980. For this purpose books and periodicals from the Regional Centre, Mandapam and Libraries of other Institutions in Cochin were also collected on inter-library loan basis.

Reprographic services—such as photocopying and electronic stencil cutting were provided to the scientists of the Institute.

The Library facilities at the Headquarters and the outstations were extended to and utilized, as usual, by researchers, teachers, scholars, students and other officials from various Universities, Institutions, Central and State Government Departments, Organizations, Industries and interested individuals as well.

Deputations abroad:

Shri S. Mahadevan, Scientist, was deputed to West Java to attend the 'Symposium on Fish Diseases' from 28-11-1978 to 1-12-1978.

Shri M. S. Muthu, Scientist, was deputed to Philippines for 12 weeks from 23-11-1978 for training in Breeding, rematuration and hatchery management at the Asian Institute of Aquaculture, SEAFDEC, Manila under the ICAR-SEAFDEC Collaborative Research Work Plan 1978-79.

Shri N. Neelakanta Pillai, Junior Scientist, was deputed for 12 weeks from 23-11-78 for training in Breeding, rematuration and hatchery management at the Asian Institute of Aquaculture, SEAFDEC, Manila, under the ICAR-SEAFDEC Collaborative Research Work Plan 1978-79.

Shri C.P. Gopinathan, Junior Scientist, was deputed to Philippines for 8 weeks from 26-2-79 for training in mass culture of fish food organisms at the Asian Institute of Aquaculture, SEAFDEC, Manila, under the ICAR-SEAFDEC Collaborative Research Work Plan.

Dr. C.M. James, Scientist 'S', was deputed to Philippines, for 8 weeks from 26-2-79 for training in mass culture of live food organisms at the Asian Institute of Aquaculture, Manila, under the ICAR-SEAFDEC Collaborative Programme.

Shri V. Mohan Raj, Junior Scientist, was deputed to Philippines for 6 weeks from 15-3-79 for training in breeding and culture of milkfish at the Department of Aquaculture, SEAFDEC, Manila, under the ICAR-SEAFDEC Collaborative Research Work Plan.

Shri V. Gandhi, Junior Scientist, was deputed to Philippines for 6 weeks from 15-3-79 for training in breeding and culture of milkfish at the Department of Aquaculture, SEAFDEC, Manila, under the ICAR-SEAFDEC Collaborative Research Work Plan.

Shri R. Marichamy, Scientist was deputed to Manila, Philippines to attend the Workshop on Pen and Cage culture of Fishes from 12-2-79 to 22-2-79.

Shri C.P. Ramamirtham, Scientist, was deputed to Philippines to participate in the Seventh FAO/SIDA workshop on Aquatic

Pollution in relation to Protection of Living Resources held at Manila from 7th May to 9th June.

Shri G. Subba Raju, Scientist, was deputed to Rome to attend the United Nations Fourth International Training Course on Application of Remote Sensing to Fisheries organised under the auspices of UN/FAO from 14-5-79 to 1-6-79.

Shri V.N. Bande, Scientist was deputed to Norway and Peru for training in Acoustic Techniques applied to fish stock assessments organised by UNDP/FAO from 19-8-79 to 3-11-79.

Shri S. Mahadevan, Scientist, was deputed to Washington U.S.A. to attend the World Meeting on Sea Turtle Conservation from 26-11-79 to 2-12-79.

Dr. E.G. Silas, Director, was deputed to Australia and Singapore from 7-5-79 to 20-5-79 to attend the Seminar and Workshop on 'Dugong Conservation in Australia/New Guinea Waters' held at Perth. He also visited the national research laboratories in Australia snd Singapore.

Dr. E.G. Silas, Director was deputed to Philippines and Bangkok from 23-6-79 to 3-7-79 to attend the FAO Tuna Consultative Meeting at Manila.

Dr. E.G. Silas, Director was deputed to Japan, Hawaii, U.S.A., U.K. and Rome to visit marine fisheries laboratories for identifying Expert consultancy and developing exchange programmes in connection with the UNDP/ICAR Centre of Advanced Studies in Mariculture at CMFRI; for locating laboratories where staff of CAS could have short-term training and for finding out type of equipments that would be required for the programme. He also attended the World Meeting on Sea Turtle Conservation held at Washington from 26-30, November 1979.

Advisory/Consultancy service provided:

Dr. E.G. Silas, Director, served as:

1. ICAR representative on the Central Council and Executive Committee of the Kerala Agricultural University, Mannuthy, Trichur.

2. Member on the joint ICAR–ICSSR Scientific Panel for Social Sciences and Agricultural Extension.

3. Member, Programme Priorities and Cruise Committee for the National Institute of Oceanography, Goa.

4. Member, Research Advisory Committee of the Kerala Agricultural University, Trichur.

5. Member, Kerala State Fisheries Research Committee.

6. Member, Central Advisory Committee on Exploratory Survey of Marine Fisheries.

7. Member, Tamil Nadu State Fisheries Research Council.

8. Member, Regional Committee No. 8 (Constituted by the Governing Body, ICAR).

9. Member, Scientific Panel for Fisheries Research, ICAR.

10. Member, Kerala State Fishery Advisory Board.

11. Member, High Level Aquarium Committee—Construction of a Marine Aquarium at Cochin.

12. Member, in the Committee on Fisheries and other Aquatic Resources of the State Committee on Science and Technology, Kerala.

13. Member, Central Government Employees Co-ordination Committee, Cochin.

14. Member, Faculty of Marine Sciences, University of Cochin.

15. Member, Executive Council and Vice-President, Indian Society of Ichthyologists, Madras.

16. Member, the Board of Management of Konkan Krishi Vidyapeeth, Dapoli, Maharashtra.

17. Member, Technical Committee of the Marine Products Export Development Authority, Cochin.

18. Member, Board of Studies in Zoology (Post-graduate) and Zoology (General and Pass) of the University of Madras for a period of three years from 20-3-76.

19. Member, Expert Committee of the Madurai University, Madurai, constituted for framing the rules, regulations and syllabus for B.Sc., Marine Science.

20. Member, Editorial Committee for 'Indian Seafoods' of the Marine Products Export Development Authority.

21. Member, Professional Board of Studies for developing Curriculam on "Post Graduate" Diploma Course in Aquaculture, Fisheries Management and Fisheries Technology.

22. Member, Committee appointed by the Board of Management of Tamil Nadu Agricultural University to select a suitable location for establishing a Fisheries College.

23. Member, Working Group for preparing a Co-ordinated Project for the collection, conservation and utilisation of fish genetic resources.

24. Member on the Expert Committee/Advisory Committee constituted to advise the Kerala Agricultural University on the organisation of a full fledged Department of Fisheries.

25. Member (ICAR representative), Management Committee, Krishi Vigyan Kendra, Pondicherry.

26. Chairman, Task Force on Inland and Estuarine Fisheries including culture programmes, Kerala State Planning Board and also served as Member, (i) Task Force on Fisheries Research and Education, (ii) Task Force on Agricultural Research and Education and (iii) Steering Committee on Fisheries Development.

27. Technical Adviser for the production of a research film on "Integrated Sea Farming-blending Culture with Capture Fisheries."

28. Member, Sub-Committee of the Indian Board of Wild-life.

29. Representative of the Department of Agricultural Research and Education to the MPEDA.

30. Member, Management Committee of Central Agricultural Research Institute, Andaman & Nicobar Group of Islands, Port Blair.

Advisory service provided/participation of scientists in advisory meetings:

Dr. S.V. Bapat, Joint Director, attended the ICAR Scientific Panel for Fisheries meeting in November and the ICAR Directors Conference held at Jodpur in December 1979. He along with Dr. P. Vedavyasa Rao, Senior Scientist attended a meeting called by the Chief Minister of Kerala at Trivandrum in April for discussing areas of operation of mechanised and non-mechanised fishing crafts.

Dr. P.S.B.R. James, Joint Director, attended the IDRC/CIFRI Workshop on Rural Fisheries held at Calcutta in February; attended a meeting of the State Level Committee for co-ordination work on Marine Fisheries in the State and Central Sector held at Madras in August and a meeting of the Rameswaram Township Development Committee held at Rameswaram in December.

Dr. P.V. Ramachandran Nair, Senior Scientist served as a Member, Inter-disciplinary Task Force in the All India Co-ordinated Research Project for generation of additional income and employment for landless agricultural labourers in the country; as a Member of the Working Group for identification of Micro-Agroclimatic zone for Kuttanad. He has been nominated last year to assist the Central Co-ordinating authority for dealing with major oil spillages in the sea.

Dr. P. Vedavyasa Rao, Senior Scientist served as a Member of the task force on Inland and Estuarine fisheries including the culture programmes constituted by the Kerala State Planning Board to formulate proposals for the development of fresh and brackishwater capture fisheries including mariculture during VI Plan.

Shri K. Nagappan Nayar, Senior Scientist, attended the 9th Meeting of the Sub-committee under the Central Advisory Committee of Exploratory Fisheries Project, Tuticorin Base held at Madras in January and also the 10th Meeting held at Madras in May.

Shri T. Tholasilingam, Senior Scientist attended the meetings of: the consortium on 'All India Co-ordinated Research Project for the generation of additional income and employment for landless agricultural labour' held at Coimbatore in June; State Level Committee for Co-ordination of work on Marine Fisheries held at Madras on 16-7-79 and served as Member Secretary in the meeting held on 10-8-79.

He served as a Member and attended the meetings of the Central Advisory Sub-committee of the Exploratory Fisheries Project-Madras base on 17-1-79, 16-5-79 and 16-7-79. In July he attended the meeting of the Scientific Advisory Committee of the National Institute of Oceanography at Goa.

Dr. S. Ramamurthy, Senior Scientist, attended the meeting of the Central Advisory Committee of the EFP, Bombay on 7-5-79 and also on 27-9-79; attended the meeting of the State Level Committee for Co-ordination of Marine Fisheries work in the State and Central Sector held at Bombay on 6-9-79 and the meeting of the Panel of Experts on Shrimp Processing held at Bombay on 9-12-79. He also attended the meeting to discuss the Muraena Report held at the Exploratory Fisheries Project, Bombay on 29-5-79.

Shri M.H. Dhulked, Scientist attended the Rural Workers Education Camp held at Karwar in February '79.

Shri S.J. Rajan, Project Officer, Operational Research Project, Kovalam, served as a Member, Executive Committee, Tamil Nadu Board of Rural Development; He has been nominated to the faculty of the Madras University for giving lectures to students in Post Graduate Diploma Course in Aquaculture.

Dr. K. Alagaraja, Scientist, participated in the Summer Institute on 'Recent advances in application of Sample Survey Methodology in Agriculture' held at IASRI, New Delhi.

Dr. T. Jacob, Senior Scientist, Dr. K. Alagaraja, Scientist, Shri S.K. Dharmaraja, Scientist, S/Shri K. Balan, K. Narayana Kurup and M. Srinath, Jr. Scientists participated in the Annual Conference of Indian Society of Agricultural Statistics held at Trichur in December.

Dr. M. V. Pai, Scientist, Shri G. G. Annigeri, Scientist and Shri K. Y. Telang, Junior Scientist participated in the Rural Worker's Education Programme for fishermen held at Karwar in February. Dr. Pai also attended the meeting convened by the Commissioner for Commerce and Industry Karnataka State at Bangalore on 14th and 15th December 79 for discussing problems connected with the removal of lime shells from Kali riverbed.

Dr. P. Vedavyasa Rao, Senior Scientist served a Member of the Board of Studies for M.Sc. (Mariculture), Faculty of Marine Sciences, University of Cochin.

List of distinguished visitors to the Headquarters, Regional Centre, Research Centres and Field laboratories of the Institute during the year 1979

Headquarters, Cochin:

1. Mr. C.E. Roper and Michael J. Sweeny, Smithsonian Institution, Washington.
2. Shri Sujan Singh, Member of Parliament and Member, Governing Body of ICAR, New Delhi.
3. Shri N. Gopinathan Nair, Special Correspondent, UNI.
4. Dr. H.R. Srinivasachar and Dr. K. Shakuntala, Department of Zoology, Bangalore University.
5. Shri C. Chellappan, Director of Fisheries, Madras.
6. Shri Kishan Singh, Director, IISR, Lucknow.
7. Mr. Keith Harry Haywood, Principal Operative Research Officer, Whitefish Authority, U.K.
8. Capt. M. Agarwal, Mazagon Docks Limited, Bombay.
9. Mr. Willem Brugge, Whitefish Authority, Hull, U.K.
10. Mr. Kai Chow, ADCP, FAO, Rome.
11. Dr. M.W.R.M. De Silva, School of Biological Sciences, University Sains, Malaysia.
12. Dr. Walter Fischer, Fisheries Resources Officer, FAO, Rome.
13. Dr. Ullrich H. Kiermayr and Dr. M.H. Gunawardena, World Bank, Washington.
14. Shri R.C. Choudhury, Chairman, MPEDA, Cochin.

15. Dr. J. Thuljaram Rao, Zonal Co-ordinator, Lab-to Land Programme, ICAR, Coimbatore.

16. Dr. J.A. Gulland, Department of Fisheries, FAO, Rome.

Prawn Culture Laboratory, Narakkal, and

Krishi Vigyan Kendra, Narakkal:

1. Shri C.D. Sharma, Director, Editing, Ministry of Agriculture, New Delhi.
2. Dr. B.B. Naghich, CPRI, Simla.
3. Dr. M.L. Shahare, Chairman, ASRB, ICAR and O.P. Bhatnagar, C.E., ASRB, New Delhi.
4. Dr. N. Balakrishnan Nair, University of Kerala, Trivandrum.
5. Dr. D.V. Bal, Former Director, Institute of Sciences, Bombay.
6. Mr. Hubert Mendis, Managing Director, Fisheries Development Corporation, Colombo.
7. Shri Sujan Singh, Member of Parliament and Member Governing Body, ICAR.
8. Dr. M.S. Swaminathan, FRS, Director-General, ICAR.
9. Shri N. Kaleeswaran, Vice-Chancellor, Kerala Agricultural University, Mannuthy.
10. Shri Philippose Thomas, IAS, District Collector, Ernakulam.
11. Dr. J.A. Gulland, Department of Fisheries, FAO, Rome.
12. Shri S.C. Mullik, CIFOODS Limited, Cuttack.
13. Shri C. Chellappan, Director of Fisheries, Madras.
14. Mr. Kai W. Chow, ADCP, FAO, Rome.
15. Hon'ble Justice S. Rangarajan, Chairman, Monopolies and Restrictive Trade Practices Commission.
16. Shri U. Vaidyanathan, Jt. Secretary and Financial Adviser, Department of Agriculture, New Delhi.

17. Shri V.M. Subramaniam, MLA, Chairman, Estimates Committee, Tamil Nadu.

18. Dr. T. Narayanan, Director (AH), Planning Commission, New Delhi.

19. Shri R.C. Choudhuri, Chairman, MPEDA, Cochin.

20. Mr. John G. Benne and Mrs. Nerina Benne, 6 Crescent Road, Ottawa, Canada.

Regional Centre, Mandapam Camp:

1. Shri Sujan Singh, Member of Parliament and Member, Governing Body of ICAR, New Delhi.

2. Shri Thomas Abraham, High Commissioner of India, at Colombo.

3. Shri T. Narayanan, Director (AH), Planning Commission, New Delhi.

4. Shri R. Krishnaswami, Chief Engineer, Tamil Nadu W& SD Board, Madras.

5. Shri C.A. Srinivasan, Chief Engineer (S & D) general Madras.

6. Shri P.V. Harihara Sankaran, Director (Personnel) ICAR, New Delhi.

7. Shri T.G. Gothi, Under Secretary, Department of Personnel & AR, ICAR.

8. Shri S.S. Parihar, Under Secretary, Ministry of Finance, New Delhi.

9. Shri V.M. Subramaniam, MLA, Chairman, Estimates Committee, Tamil Nadu.

10. Shri C. Ramdas, IAS, Special Officer, Corporation of Madras, Madras.

11. Shri R. Sakthi Mohan, Ex-MLC, Tamil Nadu.

12. Shri N.R. Jayal, Joint Secretary, Ministry of Agriculture & Irrigation, New Delhi.

13. Mr. L.A. Bedford, Chief Information Officer, U.S. Federal Wildlife Service.

Research Centre, Veraval:

1. Shri K.R. Madhavan, Fisheries Training Centre, Veraval.
2. Dr. (Mrs.) P. Umadevi and Dr. A.L. Bhatia, Department of Zoology, Univ. of Rajasthan, Jaipur.
3. S/Shri Kamaleswar Singh, Yogendra Sarma, G.H. Baghat, Nathuram Mirdha, K.K. Grover, (Members of Parliament) R.P. Gupta, Director (Hindi) Agrindia, New Delhi; Jagadish Vohra, Senior Hindi Officer, Western Railway; Ramdhanlal Minha, IAS, Asst. Collector; A.M. Bhardwaz, IAS, Dist. Collector; Shivsagar Misra, Director, Official Language, Western Railway; Ragubir Singh, Chief Mechanical Supdt., M.M.L. Sharma, Divisional Supdt., Railways, Bhava Nagar and Ravindra Varma, Divisional Operating Supdt., Railways, Bhavanagar. (all visited in connection with Second Sub-Committee of Parliament on Official Language)

Research Centre, Bombay:

1. Prof. P.N. Ganapathi, Department of Zoology, Andhra University, Waltair.
2. Mr. J.A. Gulland, Department of Fisheries, FAO, Rome.
3. Dr. Norman F. Lewis, Head, Fish & Meat Technology Section, Biochemistry & Food Tech. Division, BARC, Bombay.

Research Centre, Mangalore:

1. Shri S. Ambrose Fernando, Marine Products Exporter, Tuticorin.
2. Shri S.S. Dhanoa, Secretary, ICAR, New Delhi.
3. Shri P.F. Rodrigues, Minister for Fisheries, Govt. of Karnataka.
4. Shri C.N. Venkat Kumar, Director of Mines & Geology in Karnataka, Bangalore.
5. Shri Mitford John, Guyana, South America.

Research Centre, Karwar:

1. Shri S.S. Dhanoa, Secretary, ICAR, New Delhi.

2. Shri M. Jayaraj, Director of Fisheries, Government of Karnataka.

3. Capt. Joseph Fernandes, Director of Ports, Govt. of Karnataka.

4. Miss Ranjani Ramachandran, IAS. Probationer, Deputy Commissioner's Offiice, Karwar.

Research Centre, Calicut:

1. Shri Nathuram Mirdha, Member of Parliament and K. K. Grover, Under Secretary, Official Languages Committee.

2. Rev. Fr. Dominic George S.J., Director, S.R.C., Malaparamba, Calicut.

3. Shri Balakrishnan, District Collector, Calicut.

4. Dr. T.R. Dutta, Director, CAR, Port Blair.

5. Shri P.V. Hariharasankaran, Director, (Personnel), ICAR.

6. Prof. S.P. Varma, Indian Institute of Public Advice.

7. Shri S.S. Parhar, Ministry of Finance, Delhi.

8. Shri T. G. Gothi, Department of Personnel and AR, Ministry of Home Affairs.

9. Dr. R. Gopalakrishnan, Head Education & Extension, Centre for Water Resources Development.

Research Centre, Vizhinjam:

1. Mr. Chadwick, Commonwealth Foundation, London, UK.

2. Shri Sujan Singh, Member of Parliament & Member of ICAR Governing Body.

3. Shri N. Gopinathan Nair, Special Correspondent, UNI, New Delhi.

4. Prof. P.K. Bose, Calcutta University.

5. Mr. A.K. Dave, Chairman-cum-Managing Director, ITDC., New Delhi.

6. Mr. H.R. English, Principal System Engineer, White Fish Authority, Hull, England.

7. Dr. C.M. Singh, Director, IVRI, Izatnagar, U.P.

Research Centre, Tuticorin:

1. Shri S.S. Roy, IRS, Deputy Director of Inspection (Intelligence), Income-Tax Department, Calcutta.
2. Shri Sujan Singh, M.P. and Member of Governing Body, ICAR, New Delhi.
3. Shri C.J. Paulose, Director, Films Division, 4, Tolstoy Marg, New Delhi-1.
4. Shri T. Narayanan, Director (AH), Planning Commission, New Delhi.
5. Mr. Mitford John, Guyana Food Processors, Guyana South America (IDRC)
6. Dr. M.W.R.N. De Silva, School of Biological Sciences, University, Sains, Malaysia, Penang, Malaysia.
7. Mr. Felix Bollmann, ARTOV Tourism Development, Geneva, Switzerland.
8. Dr. Brian Moss, School of Environmental Sciences, University of East Anglia, Great Britain.
9. Shri Kartar Singh, Science Officer, British Council Division, 737, Anna Salai, Madras.
10. Mr. Mariyagracia Moucin, Student, Vie. R. De Novellis, Chieti, Italy.
11. Mr. Sr. Christiane Morand, Provincial of France, Annecy, France.
12. Mr. & Mrs. David Ware, Sheffield 1, England.

Research Centre, Madras:

1. Shri S.S. Dhanoa, Secretary, ICAR, New Delhi.
2. Shri Raj Kumar, Senior Officer, ICAR, New Delhi.
3. Shri Sujan Singh, Member of Parliament and Member of the Governing Body of ICAR.
4. Dr. Kai W. Chow, FAO.
5. Dr. E.L. Borcopgan, SEAFDEC, Philippines.

6. Shri S.M. Ali, Superintending Zoologist, Zoological Survey of India, Calcutta.

7. Dr. R. Raghu Prasad, ADG (Fisheries), ICAR, New Delhi.

8. Shri R.C. Choudhury, Chairman, MPEDA, Cochin.

Field Laboratory, Kovalam, Madras:

1. Dr. M.L. Shahare, Chairman, ASRB, ICAR, New Delhi.

2. Shri Sujan Singh, Member of Parliament and Member of Governing Body, ICAR.

3. Shri N. Gopinathan Nair, Special Correspondent, UNI, New Delhi.

4. Shri Tabom Bam, IAS, Asst. Collector (Trg) Pudukottai District.

5. Shri C. Chellappan, IAS, Director of Fisheries, Tamil Nadu.

6. Dr. B.K. Soni, Deputy Director General, ICAR.

7. Dr. A.K. Ganguly, National Fellow, BARC, Bombay.

8. Shri P.V. Hariharasankaran, Director (Personnel) ICAR, New Delhi.

9. Shri S.S. Parhar, Under Secretary, Ministry of Finance.

10. Hon'ble Justice S. Rangarajan, Chairman, Monopolies and Restrictive Trade Practices Commission, New Delhi.

11. Mr. Yoshinobu Aara, Tokyo, Japan.

12. Mr. Aloy W. Fernando, Ministry of Fisheries, Colombo, Sri Lanka.

Research Centre, Waltair:

1. Mr. Cybin and Ulbrandsen, Naval Archetects, Norway.

2. Mr. G. Pofot, Fishery Technologist, FAO.

3. Shri Ahmed Shareef, Minister for Fisheries, Govt. of Andhra Pradesh.

4. Mr. W.T. Brugge, Fishery Expert, White Fish Authority, U.K.

5. Mr. P. Tiffeney, Marketing Development Officer, U.K.
6. Shri S. Banerjee, IAS, Director of Fisheries, Andhra Pradesh.
7. Prof. P.N. Ganapathi, Chairman Achievement Audit Committee.
8. Shri K. Chidambaram, Member Achievement Audit Committee, Madras.

Research Centre, Kakinada:

1. Prof. Dr. P.N. Ganapathi, and Shri K. Chidambaram, Members of the Achievement Audit Committee of CMFRI.

Research Centre, Minicoy:

1. Shri V. Mohan Pillai, and Shri K. Appunni, Small Industries Science Institute, Trichur.
2. Shri C.C. Isaac, A.G.'s Office, Trivandrum.
3. Prof. S. Balaram, Aquarium, Trivandrum.
4. Shrimathi T. Saraswathi, S.N. College, Quilon.
5. Shri B. Unnikrishnan Nair, University of Kerala.

Symposiam, Seminars, Workshops:

The ICAR Golden Jubilee Symposium and IFARD Global Convention on Agricultural Research and Education Systems for Development were held at New Delhi from September 3—7—1979. Dr.E.G. Silas, Director, Dr. K. Alagarswami and Dr. P. Vedavyasa Rao, Senior Scientists participated in the Symposium.

Dr. P. Vedavyasa Rao and Dr. P.V. Ramachandran Nair, Senior Scientists participated in the Symposium on Inland Aquaculture from 12—14 February 1979 at Barrackpore, Calcutta.

Dr. Vedavyasa Rao attended the Seminar on Problems of Fishermen, (University of Cochin and State Resources Centre, KANFED, Trivandrum) from November 8—9, 1979 at Cochin.

Dr. Vedavyasa Rao participated in the All India Workshop on Rural Orientation Training Programme of Agricultural Research Scientists and ICAR Golden Jubilee Transfer of Technology Programme at Hyderabad from January 3—5, 1979.

The First Workshop on Technology Transfer in Coastal Aquaculture, under the Lab-to Land Programme was organised by the Institute from July 23—24, 1979 at Cochin and also at Mandapam during July. Scientists, farmers and development agencies participated in the workshop.

Exhibitions:

The Institute participated in the All India Agricultural, Industrial and Educational Exhibition organised by the Rotary Club of Cochin from February to April 1979. The Institute won the First Prize jointly with CIFT for the best stall from Government establishments.

The Institute also participated in the 'Cashew-79' exhibition organised by the CPCRI, Kasargode from 12—18 March 1979 in connection with the International Cashew Symposium.

Participation in radio programmes/radio talks given by scientists:

NAME OF SCIENTIST	SUBJECT, DATE, A.I.R. STATION
1. Dr. R.S.Lal Mohan	—The delightful dolphins...18-3-79 Calicut.
2. Dr. P.S. Kuriakose	—Tuna fishing in Minocoy Island... 23-3-1979...Calicut.
3. Dr. N. Gopinatha Menon	—Importance of tagging in marine fisheries research...25-3-79...Calicut.
4. -do-	—Prawn culture ...29-3-79...Calicut
5. -do-	—Kadalinadiyil...19-10-79...Calicut
6. Shri T.M. Yohannan	—Science for fishing...26-10-79.
7. Shri C.V. Mathew	—Phyto-zooplankton and its role in fisheries...1-12-79...Calicut.

8. Shri M.H. Dhulkhed	—'Sagar matsya sampathu mattu utpathi'...a radio interview in Kannada...13–9–79...Mangalore
9. AIR	—Marine Fisheries and Mangalore Research Centre of CMFRI... 22–9–79...(in Kannada)
10. Shri S. Reuben	—Research results of the Waltair Research Centre of CMFRI...in Telugu...September 79...Visakhapatnam.
11. Shri V.D. Deshmukh	—Achievements of the Bombay Research Centre of CMFRI...talk in Marathi...22–11–79...AIR, Bombay.
12. Dr. M.V. Pai	—Contribution and achievements of the Karwar Research Centre of CMFRI ...in Kannada...29–12–79 Dharwar.

T.V. Programme:

Shri V. Selvaraj	—Concept of Operational Research Project and its activities at Kovalam...26–11–79...Madras T.V.

Awards:

The ICAR Hari Om Trust Award for the year 1976 has been awarded to Dr. K. Alagarswami, Senior Scientist of the Institute, in the field of Fisheries (pearl culture). The Citation of the award reads as follows:

> *" Dr. Alagarswami developed successfully the technique of Pearl Culture for the first time in India. Although, the principles of pearl culture were already known, it has not been possible to apply these in field operations until appropriate techniques were developed by Dr. Alagarswami. The contribution is particularly commendable in that this pioneering work has been based entirely on indigenous effort and know-how. In barely 43 days after the operation and implantation of the nucleus the first spherical and lus-*

trous pearl was produced. Following this success, a pearl-oyster farm has been established at Tuticorin (Tamil Nadu). The development of the technique of raft culture, multiple implantation of nuclei to enhance rate of pearl production, production of spherical shell beads from conch-shell waste for use as nuclei, production of special surgical tools required for the operation of pearl oysters and diversification of techniques for re-use of oysters in pearl production are some of the important contributions made by Dr. Alagarswami.

The contributions made by Dr. Alagarswami and the training courses conducted by him in pearl culture techniques have laid the foundation for a pearl culture industry in India."

Sports:

The Institute participated in the South Zone tournaments organised by the ICAR in connection with the Golden Jubilee Celebrations. The Institute's performance in both athletics and games were generally good. Shri S. Reuben, Jr. Scientist won the runners-up trophy in Shuttle Cock (Singles). At least in 9 events the athletes of the Institute won the 1st or 2nd place.

The Institute fielded a small team of 4 athletes for the Inter-Zone Finals at Hyderabad. Shri V. Achutha Rao of the Institute won the coveted individual athletic championship of the ICAR for winning in 3 events.

Finance:

The Budget allotment of the Institute and the actual expenditure during the financial year 1979-80 is given in the accompanying Table.

Budget allotment and expenditure during 1979—80 (in Rupees)

	NON-PLAN		PLAN	
HEADS	ALLOTMENT	EXPENDITURE	ALLOTMENT	EXPENDITURE
1. Salary and Allowances	74,59,000	72,65,249.13	—	—
2. Travelling Allowances	2,75,000	2,75,417.47	2,92,900	2,92,840.12
3. Other charges:				
Assets Acquired	3,00,000	2,35,130.74	58,10,000	58,05,514.73
4. Office contigencies	7,06,000	6,81,538.15	8,40,000	8,39,407.74
5. Other Expenditure	7,80,000	7,05,489.74	36,35,000	36,40,234.08
6. Recruitment Expenditure	14,000	13,420.90	2,100	1,260.14
	95,34,000	91,66,246.13	1,05,80,000	1,05,79,256.81

PROGRESS OF RESEARCH

FISHERY RESOURCES ASSESSMENT DIVISION

Sample Survey for estimation of marine fish production and the effort expended (FSS/FRA/1.1)

Annual production of marine fish

The estimate of all India marine fish landings in 1979 was 1.39 million tonnes as against 1.40 million tonnes in 1978, thus showing a marginal reduction of about 1%. This reduction was mainly brought about by the fall in the catches in the States of Kerala and Karnataka, the decline in these States being to the tune of about 43,000 and 26,000 tonnes respectively. A feature noticed was that while the landings increased in all the maritime States on the east coast except West Bengal the same showed a decline in all the maritime States in west coast except in Maharashtra. Of the commercially important species, mackerel and oil sardine showed a decline in their catches to the extent of about 14,000 tonnes each. The landings of Bombay duck did not show much variation. A significant fall to the tune of about 15,000 tonnes in the landings of penaeid prawns was noticed during the year though the overall prawn catches remained more or less the same. Some of the species that showed an increase in their landings were lesser sardines, silver bellies, tunnies, *Caranx* catfish and seerfish, the increase in the catch being about 15,000, 14,000, 13,000, 12,000, 10,000 and 9,000 tonnes respectively. Table 1 shows details of the State-wise annual marine fish landings for the years 1979 and 1978.

State-wise Marine Fish Production

West Bengal

A decline of about 2,000 tonnes in the total landings as com-

pared with that of 1978 was observed. (Table 1). This was mainly due to fall in the catches of sciaenids, prawns, *Thrissocles* and ribbonfish by about 860, 700, 500 and 390 tonnes respectively. However, the landings of pomfrets, *Hilsa ilisha*, other clupeids and seerfish showed an increase of 640, 470, 340 and 280 tonnes respectively.

Orissa

The rising trend in the catches observed in 1978 continued during this year also, the increase being 12,000 tonnes as compared to 1978 (Table 1). Higher landings of pomfrets, *Hilsa ilisha*, seerfish and elasmobranchs were observed, the increase being 4,400, 2200, 1,400 and 950 tonnes respectively. Marginal decline in the catches of *Anchoviella*, other species of *Hilsa* and catfish was noticed.

Andhra Pradesh

A notable feature observed during the year was the increase in the total landings after a steady decline from 1974 to 1978. The increase in 1979 was about 9,300 tonnes over that of previous year, the species that contributed to the increase being sciaenids (3,200 t), seerfish (2,900 t), prawns (2,300 t), *Thrissocles* (1,600 t) and *Leiognathus* (1,400 t). However, the landings of *Anchoviella*, elasmobranchs and lesser sardines showed a decline.

Tamil Nadu

A total catch of about 2.35 lakh tonnes was noticed, this being the highest so far recorded in this State. This is mainly due to increase in the catches of silver bellies (12,700 t), other sardines (12,200 t), sciaenids (4,700 t), *Caranx* (3,900 t), *Anchoviella* (3,600 t), mackerel (2,000 t) and tunnies (2,000 t). Ribbonfish fishery which showed a striking increase in the catch during 1978, declined during the year by about 7,600 tonnes. Penaeid prawns showed a decline of about 3,100 tonnes. The landings of other crustaceans, perches and elasmobranchs also declined.

Pondicherry

During 1979, the total landings increased by about 3,200 tonnes as compared to 1978. This was brought about by the increase in the catches of lesser sardines (800 t), perches (500 t),

Leiognathus (400 t), flyingfish (400 t), *Caranx* (300 t), penaeid prawns (300 t) and mackerel (250 t). *Anchoviella* and catfish showed a slight decline.

Kerala

A decline of about 43,000 tonnes in the total landings was observed during the year as compared to 1978. The decline in 1979 is mainly due to the decrease in the landings of penaeid prawns (15,500 t), *Anchoviella* (14,600 t), sciaenids (7,800 t), mackerel (7,300 t), cephalopods (3,500 t), oil sardine (3,000 t), seerfish (3,000 t), soles (2,800 t) and elasmobranchs (2,300 t). The substantial decline in the catch of penaeid prawns in Sakthikulangara during 1979 is mainly responsible for the overall decline in the landings of penaeid prawns in this state. There was an increase in the landings of tunnies (8,800 t), other crustaceans (5,500 t), *Caranx* (5,100 t), other sardines (4,200 t) and catfish (2,200 t).

Karnataka

There was a decline in the landings to the tune of 26,500 tonnes in 1979 as compared to 1978. Decreased landings of oil sardine (13,600 t) and mackerel (10,600 t), were mainly responsible for this decline. The catch of penaeid prawn also showed a decrease to the extent of about 3,800 tonnes. However, the landings of catfish showed an increase of about 7,100 tonnes.

Goa

A decrease of about 1,700 tonnes in the total catch was noticed during 1979. The landings of other sardines, sciaenids, perches and catfish decreased by about 2,700, 1,800, 600 and 500 tonnes respectively. However, oil sardine and mackerel showed a marginal increase to the tune of about 1,600 and 1,000 tonnes respectively.

Maharashtra

The total catch in Maharashtra in 1979 registered an increase of about 9,000 tonnes, over that of 1978. The catch of non-penaeid prawns, penaeid prawns and sciaenids, increased by about 12,000 tonnes, 4,500 tonnes and 4,200 tonnes respectively. However, there was a decline in the catch of Bombay duck by about 9,000 tonnes.

Gujarat

The total landings in Gujarat declined marginally by about 10,600 tonnes. The landings of other clupeids, elasmobranchs, pomfrets and sciaenids decreased by about 7,700, 6,600, 5,800 and 5,700 tonnes respectively. There was an increase in the landings of Bombay duck during 1979 by about 10,000 tonnes as compared to 1978.

Andamans

The total landings in Andamans remained more or less same in both 1979 and 1978. The species composition also did not show much variation.

Lakshadweep

An increase of about 1,100 tonnes in the total catch was noticed as compared to 1978. This was due to increase in the landings of tunnies (900 t) and elasmobranchs (200 t).

Species composition

Table 2 shows the composition of marine fish catch in India during 1979 and 1978.

Pelagic and demersal group of fishes

Both pelagic and demersal groups of fishes showed a marginal decline during 1979. The catch of the former group and the latter group amounted to 7.48 lakh tonnes and 6.40 lakh tonnes respectively, the decline in the respective landings being 2.4% and 1.6% as compared to 1978.

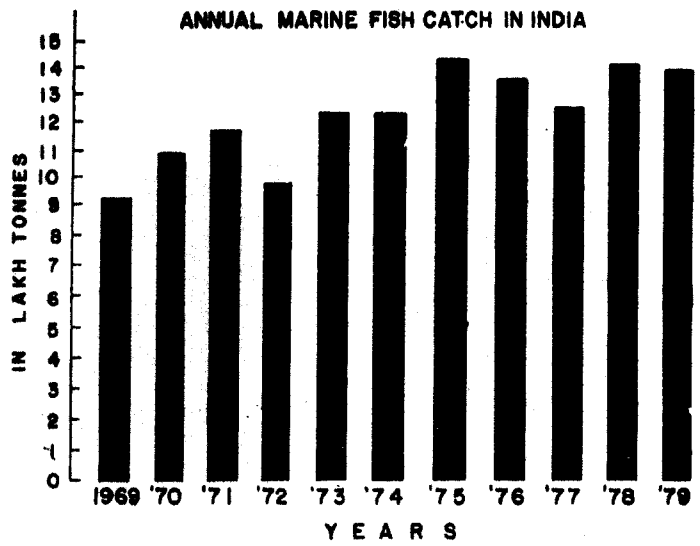
Pelagic group of fishes

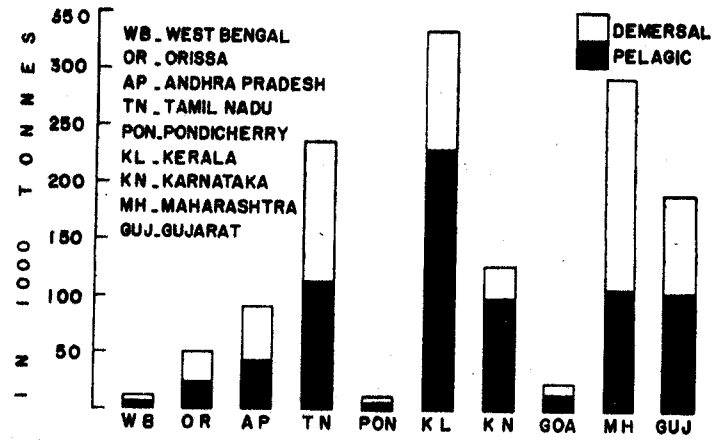
Oil sardine

A decline of about 14,000 tonnes of oil sardines was noticed during the year 1979. This was brought out by the decreased landings in Karnataka and Kerala, the former accounting for the major portion.

Mackerel

This fishery also showed a decline of about 14,000 tonnes in the landings mainly due to lesser catches in the States of Karnataka and Kerala, the quantum of reduction being higher in the former.





PELAGIC AND DEMERSAL CATCH IN DIFFERENT STATES DURING 1979

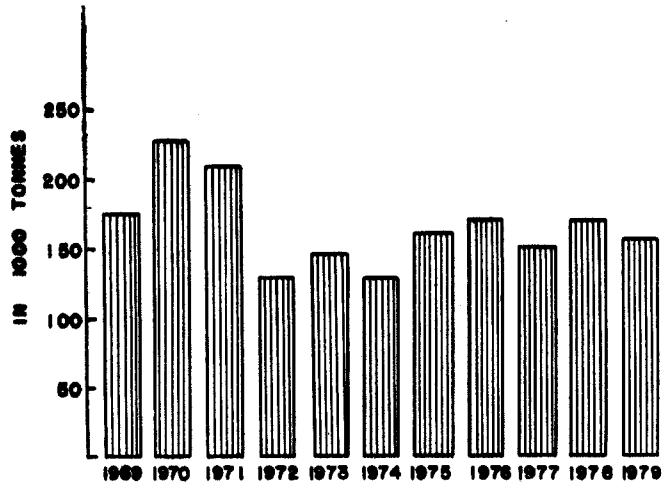


Fig. 3. *Landings of oil sardine*

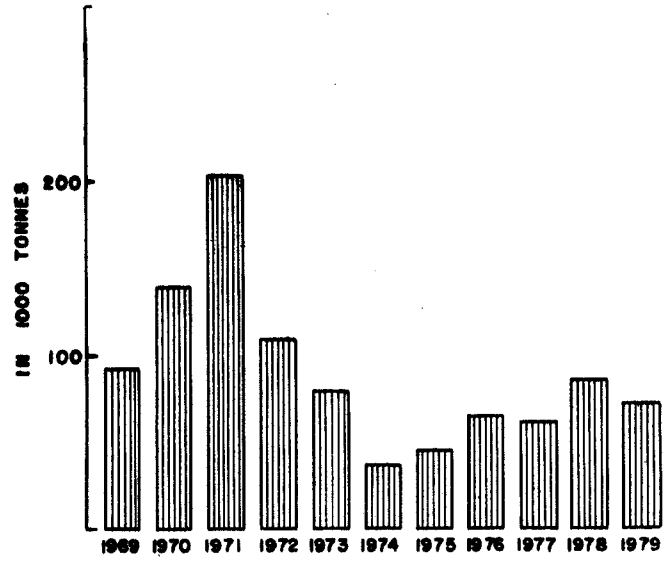


Fig. 4. *Landings of mackerel*

Bombay duck

The overall catch of Bombay duck remained more or less same as that of last year. An improvement in its catch noticed in Gujarat to the tune of about 10,000 tonnes was offset by a decline in the catch to the same extent in Maharashtra.

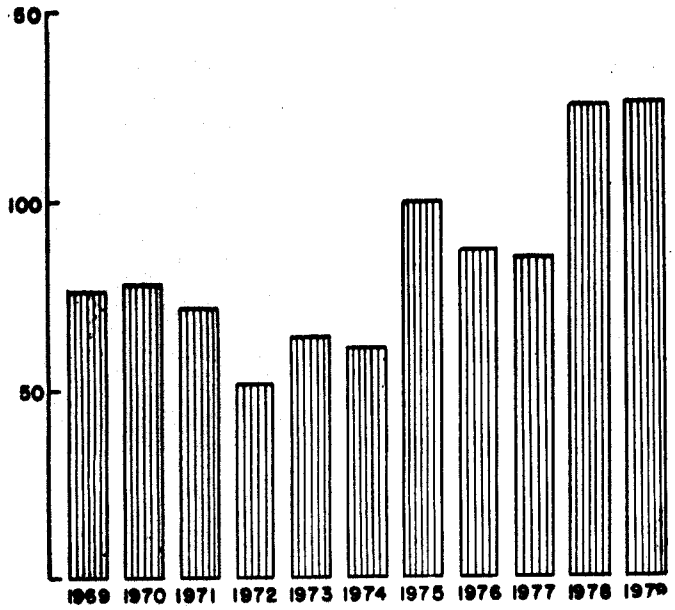


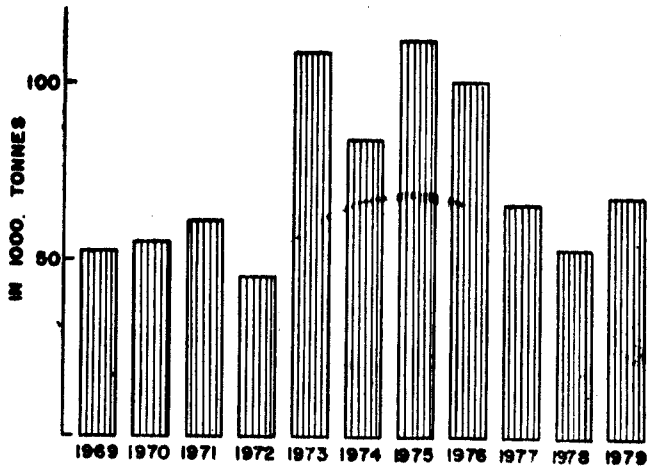
Fig. 5. Landings of Bombay duck

Other sardines

There was a significant increase of about 15,000 tonnes during this year as compared with 1978. Higher landings in Tamil Nadu to the tune of about 12,000 tonnes were mainly responsible for the improvement in the total catch. Kerala and Pondicherry also contributed to this increase.

Anchoviella

The total catch of *Anchoviella* showed a sharp fall of about 12,500 tonnes as compared with that of 1978. The major part of the decline was observed in Kerala (14,700 t). However, there was some increase in the landings in Tamil Nadu (3,600 t).



Landings of lesser sardines

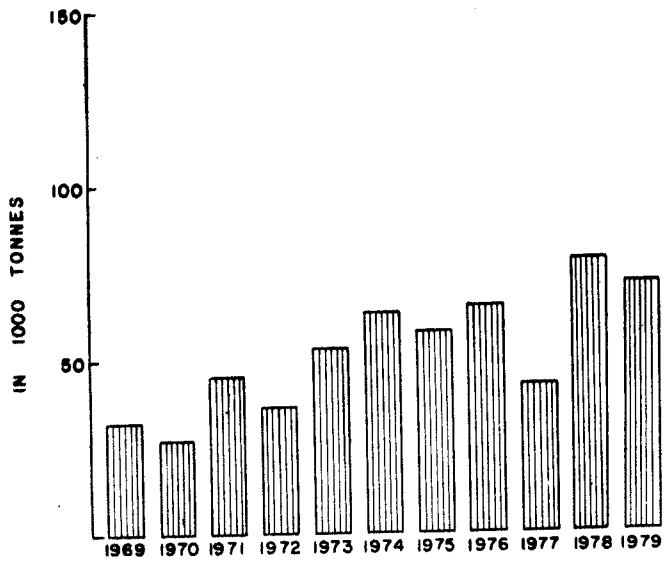
Tunnies

The landings of tunnies were almost double as that of 1978, the States that contributed to this increase being Kerala (9,000 t), Tamil Nadu (2,000 t), Karnataka (1,100 t) and Lakshadweep (900 t).

Caranx

An increase of about 12,000 tonnes in the total catch was observed during 1979 over that of 1978. Kerala (5,100 t), Tamil Nadu (3,900 t), Andhra Pradesh (1,200 t) and Karnataka (900 t) mainly accounted for this increase.

Among other pelagic group of fishes, while seerfish showed an increase of about 9,000 tonnes, ribbonfish showed a decrease of about 6,000 tonnes.



Landings of ribbon fish

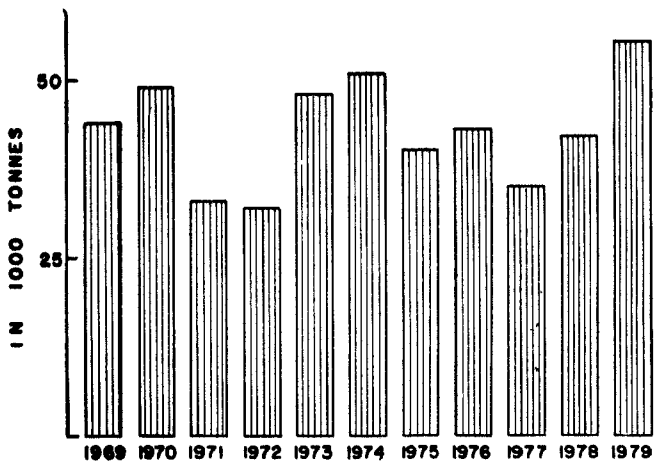
Demersal group of fishes

Silver bellies

The landings of silver bellies continued to show a rise during 1979, the increase in the total catch during the year being about 14,000 tonnes over that of 1978. This was brought about by a substantial increase in their landings in Tamil Nadu by about 12,700 tonnes.

Perches

The total catch of perches of this year showed a decline of about 14,000 tonnes over that of 1978. The States that showed a decrease in the catch were Kerala (4,700 t), Maharashtra (3,700t), Tamil Nadu (3,300 t) and Gujarat (3,200 t).



Landings of silver bellies

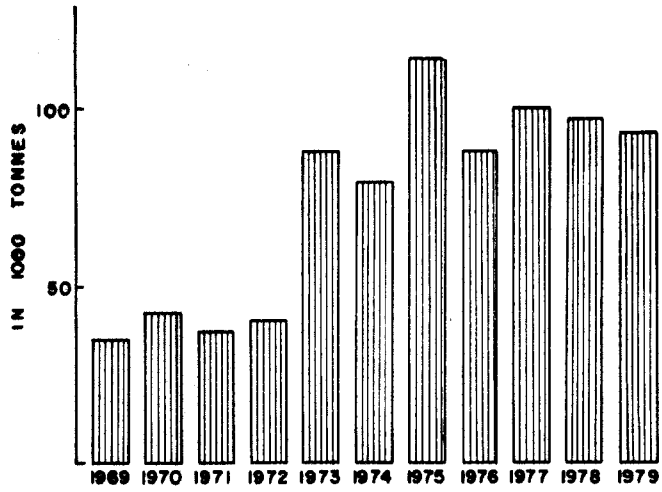
Catfish

The total catch of catfish showed an increase of about 9,600 tonnes as compared to 1978. This increase was mainly due to increased 'landings in Karnataka (7,000 t) and Kerala (2,200 t).

Some of the demersal group of fishes that showed decrease landings were elasmobranchs (8,800 t), *Lactarius* (3,400t) and sciaenids (3,400 t).

Penaeid prawns

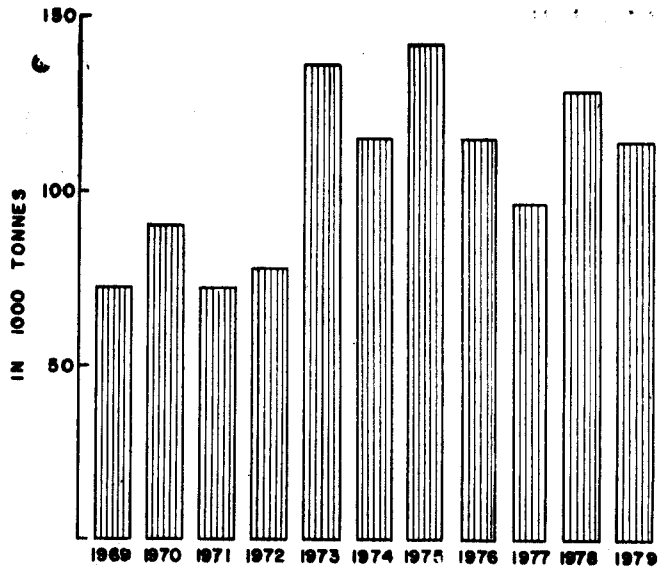
A decline to the extent of 15,500 tonnes was observed in the total catch of penaeid pawns during 1979 as compared to 1978. while Kerala, Karnataka and Tamil Nadu showed decreased landings by about 15,500, 3,800 and 3,100 tonnes respectively, Maharashtra, Gujarat, Andhra Pradesh and Orissa showed an increase of about 4,500, 670, 670 and 380 tonnes resepctively.



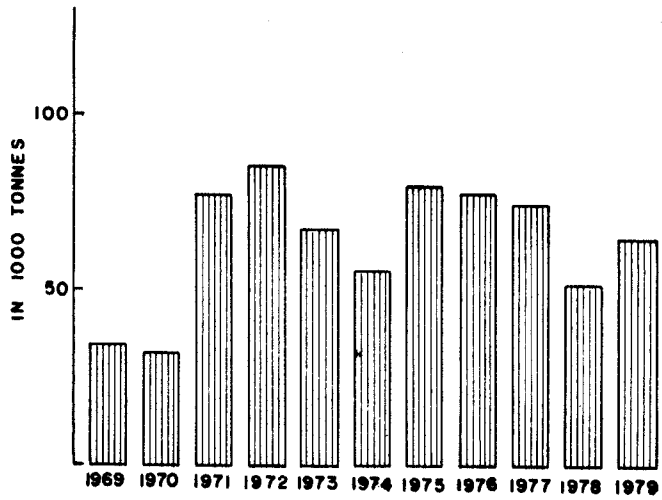
Landings of sciaenids

Non-penaeid prawns

An increase of about 13,000 tonnes in the landings was observed during this year as compared to that of 1978. Maharashtra (12,000 tonnes) mainly contributed to this increase.



Landings of penaeid prawns



Landings non-penaeid of prawns

Crabs and other crustaceans

The landings of crabs and other crustaceans showed an increase of about 6,100 tonnes as compared to 1978. Kerala, Karnataka and Goa recorded increased catches by about 5,500, 2,000 and 850 tonnes respectively. However, there was a decline of about 3,400 tonnes in the catch in Tamil Nadu.

Cephalopods

Though the overall catches remained more or less the same during 1979 and 1978 the catches of cephalopods as compared to previous year in different states showed wide variations. Kerala, Karnataka and Maharashtra showed a decrease of about 3,500, 1,300 and 600 tonnes respectively. On the other hand Gujarat and Tamil Nadu showed increased landings to the extent of 3,400 and 860 tonnes respectively.

Fishing effort

The total fishing effort expended in the maritime States (excluding Andamans and Lakshadweep) showed an increase of about 2,600 thousand man hours during 1979 as compared to 1978 (Table 3). Except Karnataka, Maharashtra and Gujarat all the maritime States of India recorded higher input of effort during the year. The overall catch per unit of effort did not vary much as compared to that of 1978.

Exploratory survey

The offshore catch data of the Exploratory Fishery Project and Integrated Fishery Project vessels which operated from the bases at Veraval, Bombay, Goa, Mangalore, Cochin, Tuticorin, Madras, Vishakaphatnam and Calcutta were analysed. The total offshore catch recorded during the year was 1,710 tonnes as compared to 1,590 tonnes during 1978. The details are shown in Tables 4 and 5 for the category of depths, one showing upto 40 m. depth and the other showing 40 m. and above.

Upto 40 m. depth

The total landings for all the bases in this depth range worked out to 1,170 tonnes as compared to 832 tonnes in 1978 show-

ing an increase of 338 tonnes. Cochin base recorded the highest catch of 808 tonnes forming about 69% of the total offshore catch, followed by Tuticorin base with 142 tonnes (12%). Mangalore base with 78 tonnes (7%) and Goa base with 70 tonnes (6%). The catches of catfish and elasmobranchs amounted to 87 and 76 tonnes respectively. The category of fish coming under miscellaneous group comprising sciaenids, perches, polynemids etc. formed the bulk of the catch. The total fishing effort expended during 1979 in this depth range was 5,866 fishing hours as compared to 4,713 fishing hours during 1978, the corresponding catch per unit effort being 199 Kg. and 176 Kg. respectively.

40 *m. and above*

A decline of 218 tonnes in the total catch was observed during 1979 as compared to 1978. A maximum catch of 176 tonnes (33%) was recorded in Cochin base, followed by Visakapatnam, 146 tonnes (27%) and Bombay 106 tonnes (20%). Two major fishes that contributed to the landings were catfish (113 tonnes) and elasmobranchs (66 tonnes), bulk of the remaining catch being from miscellaneous group of fishes. The total fishing effort expended declined to 5,029 fishing hours in 1979 from 6,520 fishing hours recorded in 1978, the corresponding catch per unit effort being 107 Kg. and 116 Kg. respectively.

Frame Survey (FSS/FRA/FS 1.2)

It was decided to conduct next census of marine fishermen population and infrastructure facilities available along the coast line of India during summer of 1980 and the planning for carrying out the same was done during the year. Various schedules for collection of data on number of fishermen, their educational level, occupational status, the number of crafts and gears possessed by them, landing facilities, number of ice plants, cold storages etc. were prepared. The personnel required for this massive task were identified.

Stock assessment and estimation of potential yield of commercially important fishes (FSS/FRA/FS 1.3)

In connection with the above study collection of gearwise length-frequency data on oil sardine, mackerel, Bombay duck

and penaeid prawns was continued. Work on stock assessment on oil sardine was carried out and some of the results have been published in the *Marine Fisheries Information Service No.* 14.

National Fishery Data Centre (FSS/FRA/ST. 1)

The work of coding and punching of fishery data was augmented during the year at the National Fishery Data Centre of the Institute with the recruitment of six punch card operators who were given intensive training in punching and coding. Part of the regular survey and socio-economic data was coded and punched.

Standardisation of fishing effort (FSS/FRA/1.4)

During the year, gearwise estimates of catch and effort in resepct of marine fish landings in Karnataka for the year, 1977, 1978 and part of 1979 were obtained for standardisation of fishing effort in respect of oil sardine and mackerel. Further work is in progress.

Survey of estuarine fisheries (FSS/FRA/1.5)

Survey work could not be taken up for want of staff.

Exploited marine fisheries resources of the maritime States (FSS/FRA/1.6)

The work relating to the compilation and analysis of detailed data pertaining to Karnataka for the years 1977 to 1979 was taken up. Further work is in progress.

Socio-economic surveys of small scale fisheries at selected centres (FSS/FRA/1.7)

Basic infomation in respect of the number of houses, fishermen population, number of crafts and gears, infrastructure facilities income and expenditure of selected fishermen families in Manakudy, Calicut and Vizhinjam was collected. A study was conducted on coastal rural indebtedness at Vizhinjam area to find out the extent of indebtedness of fishermen and also to examine the credit system prevailing in the area.

Impact of purse-seine operations on the socio-economic conditions of traditional fishermen (FSS/FRA/1.8)

A special survey was conducted in the Karnataka coastal villages to investigate the socio-economic consequences of rampani fishermen due to commercial purse-seine operations. The study indicated that the landings from purse seines have been steadily increasing from 1977, especially in the South Kanara coast. At the same time the landings from traditional rampani gears showed a sharp decline, South Kanara being the worst hit. This adversely affected their income and resulted in many being thrown out of employment. The detailed results have been published in *Marine Fisheries Information Service No.* 12.

Impact of mechanised fishing on the socio-economic conditions of fishermen in Sakthikulangara—Neendakara area (FSS/FRA/1.9)

Preliminary information on the number of wards in the panchayats of Sakthikulangara and Neendakara wherein the fishermen population predominate, the total fishermen population, infrastructure facilities available etc. was collected. Proformae for collection of detailed data were designed and steps were taken to recruit enumerators for this purpose.

Training in fishery resources assessment including population dynamics (CMFRI/TR/6)

The second batch of twelve trainees deputed by State Fisheries Departments, Agricultural Universities and this Institute took part in the training during November–December 1979.

Economics of marine fisheries in the Calicut area (IIP/4)

Report relating to the first phase of work is under preparation.

Personnel associated with the various projects of the Division

T. Jacob, G. Venkataraman, K, Alagaraja, S. K. Dharmaraja, K.K.P. Panikkar, R. Sathiadas, M. Srinath, K.Narayana Kurup, K. Balan, B. Prasanna Kumari, K. Vijayalakshmi, A. S. Kaikini, C. R. Shanmugavelu, M. G. Dayanandan, Syed Basheeruddin, S. S. Dan, G. Balakrishnan and Technical staff at headquarters and Field Centres.

TABLE--1

State-wise marine fish landings in India for 1979 and 1978 in tonnes

	State / Source	1979	1978
1.	West Bengal*	10,744	12,754
2.	Orissa	51,808	39,670
3.	Andhra Pradesh	91,426	82,116
4.	Tamil Nadu	2,35,008	2,12,899
5.	Pondicherry	10,068	6,828
6.	Kerala	3,30,509	3,73,339
7.	Karnataka	1,26,384	1,52,860
8.	Goa	25,388	27,111
9.	Maharashtra	2,93,326	2,84,244
10.	Gujarat	1,91,312	2,01,929
11.	Andamans	1,721	1,579
12.	Lakshadweep	3,846	2,780
13.	Private trawlers**	16,840	5,498
	Total	13,88,380	14,03,607

**Contai coast only.*

***Partial coverage of larger trawlers.*

TABLE--2

The composition of total marine fish landings in India during 1979 and 1978 in tonnes.

Name of fish	1979	1978
Elasmobranchs	52,843	61,621
Eels	7,155	8,781
Cat fishes	48,817	39,231
Chirocentrus	10,274	10,990
Oil sardine	1,53,971	1,68,078
Other sardines	68,351	52,838
Hilsa ilisha	12,068	9,894
Other *Hilsa*	8,672	12,800
Anchoviella	26,588	39,054
Thrissocles	16,628	14,304
Other clupeids	33,965	37,020
Harpodon nehereus	1,26,044	1,25,481
Saurida & Saurus	11,154	10,808
Hemirhamphus & Belone	1,577	1,478
Flying fish	2,546	1,681
Perches	35,657	49,312
Red mullets	3,130	2,984
Polynemids	5,809	5,469
Sciaenids	93,018	96,379
Ribbon fish	71,349	77,785
Caranx	28,942	16,956
Chorinemus	3,307	3,359
Trachynotus	195	106
Other carangids	465	423
Coryphaena	146	64
Elacate	880	568
Leiognathus	55,266	41,777
Gazza	197	104
Lactarius	4,474	7,906
Pomfrets	40,427	41,434

Table-2 (contd.)

Name of fish	1979	1978
Mackerel	71,514	85,233
Seer fish	29,547	20,779
Tunnies	26,595	13,893
Sphyraena	2,265	3,709
Mugil	1,400	2,626
Bregmaceros	638	184
Soles	12,203	13.620
Penaeid prawns	1,13,665	1,29,204
Non–penaeid prawns	63,917	50,652
Lobster	1,135	1,307
Other crustaceans	20,304	14,202
Cephalopods	15,032	15,931
Miscellaneous	1,06,250	1,13,582
Total	13,88,380	14,03,607

TABLE--3

Estimated fishing effort and catch per unit effort during 1979 and 1978

Sl. No.	Name of State	Fishing effort (1000 man hours)		Catch per effort (in kg.)	
		1979	1978	1979	1978
1.	West Bengal	6,207	4,428	1.73	2.88
2.	Orissa	28,183	21,362	1.84	1.86
3.	Andhra Pradesh	51,772	48,883	1.77	1.68
4.	Tamil Nadu	75,410	73,804	3.12	2.88
5.	Pondicherry	3,062	2,292	3.29	2.98
6.	Kerala	53,656	50,725	6.18	7.36
7.	Karnataka	10,458	17,659	11.88	8.66
8.	Goa	5,047	2,921	5.03	9.28
9.	Maharashtra	34,509	38,605	8.50	7.36
10.	Gujarat	25,890	30,883	7.62	6.54
	Total (excluding Andamans and Lakshadweep)	294,194	291,562	4.64	5.03

TABLE--4

Catch and effort details of Exploratory Fisheries Project vessels during 1979

Depth upto 40 M

Base	Effort (Trawling hours)	Prawns (kg)	Elasmo-branchs (kg)	Cat-fish (kg)	Miscellaneous (kg)	Total (kg)
Veraval	—	—	—	—	—	—
Bombay	147.83	43.00	1885.00	720.00	7544.00	10192.00
		(0.29)	(12.75)	(4.87)	(51.03)	(68.94)
Goa	593.30	390.80	1638.00	19858.00	47815.00	69701.80
		(0.66)	(2.76)	(33.47)	(80.59)	(117.48)
Mangalore	949.85	691.00	2081.00	12555.00	62294.00	77621.00
		(0.73)	(2.19)	(13.22)	(65.58)	(81.72)
Cochin	2063.10	542.00	21239.50	47993.00	738724.50	808499.00
		(0.26)	(10.29)	(23.26)	(358.07)	(391.89)
Tuticorin	1335.00	10.50	31839.50	630.50	109951.75	142432.25
		(0.01)	(23.85)	(0.47)	(82.36)	(106.69)
Madras	244.89	66.00	1555.00	612.00	9946.00	12179.00
		(0.27)	(6:35)	(2.50)	(40.61)	(49.73)

Table–4 (contd.)

Base	Effort (Trawling hours)	Prawns (kg)	Elasmo-branchs (kg)	Cat-fish (kg)	Miscellaneous (kg)	Total (kg)
Visakhapatnam	151.95	12.80	478.50	1943.00	7628.50	10062.80
		(0.08)	(3.15)	(12.79)	(50.20)	(66.22)
Calcutta	380.50	147.00	15001.50	2809.50	21482.75	39440.75
		(0.39)	(39.43)	(7.38)	(56.46)	(103.66)
Total	5866.42	1903.10	75718.00	87121.00	1005386.50	1170128.60
		(0.32)	(12.91)	(14.85)	(171.38)	(199.46)

N.B.--Figures in the brackets indicate the catch per unit effort in kg/hr.

TABLE--5

Catch and effort details of Exploratory Fisheries Project vessels during 1979—Depth above 40 M

Base	Effort (Trawling hours)	Prawns (kg)	Elasmo-branches (kg)	Cat-fish (kg)	Miscella-neous (kg)	Total (kg)
Veraval	167.50	—	798.00 (4.76)	340.00 (2.03)	20894.00 (124.74)	22032.00 (131.53)
Bombay	970.50	17.00 (0.02)	16077.00 (16.57)	21095.00 (21.74)	68448.00 (70.53)	105637.00 (108.58)
Goa	116.50	356.00 (3.06)	1019.00 (8.75)	11665.00 (100.13)	17227.00 (147.87)	30267.00 (259.80)
Mangalore	85.35	—	135.00 (1.58)	1476.00 (17.29)	9339.00 (109.42)	10950.00 (128.29)
Cochin	1252.10	583.00 (0.47)	35659.00 (28.48)	49333.00 (39.40)	90914.00 (72.61)	176489.00 (140.95)
Tuticorin	25.00	—	441.00 (17.64)	76.00 (3.04)	1387.00 (55.48)	1904.00 (76.16)
Madras	572.11	—	751.00 (1.31)	444.00 (0.78)	34511.00 (60.32)	35706.00 (62.41

Table–5 (contd.)

Base	Effort (Trawling hours)	Prawns (kg)	Elasmo-branchs (kg)	Cat–fish (kg)	Miscella-neous (kg)	Total (kg)
Visakhapatnam	1749.79	71.65	8820.00	27100.00	110336.10	146327.75
		(0.04)	(5.04)	(15.59)	(63.06)	(83.63)
Calcutta	90.50	136.50	2428.00	1144.50	6983.50	10692.50
		(1.51)	(26.83)	(12.65)	(77.17)	(118.15)
TOTAL	5029.35	1164.15	66128.00	112673.50	360039.60	540005.25
		(0.23)	(13.15)	(22.40)	(71.59)	(107.37)

N.B.--Figures in the brackets indicate the catch per unit effort in kg/hr.

FISHERY BIOLOGY DIVISION

a. Pelagic Fisheries

The fishery and resource characteristics of Oil sardine (*FB/PR*/1.1)

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There was a general decrease in the Oil sardine fishery during the year at most of the centres except at Cochin and Karwar. A significant feature of the fishery was the increased purse seine operations at Karwar, Mangalore and Cochin resulting in increased catches and striking decline in the catches of indigenous gears at Mangalore and Karwar Centres. The decrease in oil sardine landings at Calicut was due to the decreased fishing effort by the indigenous gear. The fishery was mainly supported by O–year and 1–year classes at the northern centres and by O–year, 1–year and 2–year classes at the southern centres. Recruitment of *Juveniles* appeared to be good at all centres.

Investigations on the fishery and biological characteristics of the oil sardine resource were carried out at Cochin, Calicut, Mangalore, Karwar and Goa centres.

The fishery at Cochin during the year yielded an estimated catch of 6313 tonnes as compared to 2663 tonnes of last year. Of the total catch, purse seines contributed to 2539 tonnes and the rest by the indegenous gear. Of the principal gear employed in the fishery, the catch rates (catch/boat/day) for purse seine and Thanguvala were in the order of 3707 kg. and 444 kg. respectively. The fishery during the year was supported mainly by the 0–year class (79.4%) and by the 1–year class (14.6%). Females were predominant in the catches. Fishes in advanced stages of maturity were recorded during May–August. Good recruitment of Juveniles in the fishery was observed from August/ September onwards.

Age composition in the catch per unit effort of oil sardine at different centres during 1978 and 1979

Place & Gear		1978 O–year	1978 1–year	1978 2–year & above	1979 O–year	1979 1–year	1979 2–year & above
Goa:	P. S.	...	No data	...	13,912	1,854	4,114
Karwar:	R. P.	8,517	487	552	4,737	406	515
	P. S.	12,810	16	11	42,309	19,844	1,786
Mangalore:	P. S.	97,796	10,651	5,149	22,122	13.358	3,383
Calicut:	P. K.	14,271	1,978	1,294	7,316	6,473	3,542
Cochin:	T. V.	7,522	3,061	576	14,230	2,910	777
	P. S.	...	No data	...	123 708	19,950	11,707
Total		1,40,916	16,193	7,582	228,334	64,795	25,824

P. S. = Purse seine, R.P. = Rampani, P.K. = Pattenkollivala,
T. V. = Thanguvala
Age: O–year (<149 mm), 1–year (150–179 mm), 2–year (180 mm—).

The yield from the fishery at Calicut was lower during the year with an estimated catch of 4634 tonnes as compared with the previous year's catch of 6293 tonnes. Indigenous gears like Pattenkollivala and Mathi chala vala were the principal gears employed in the fishery. This decrease in the landings was due to decreased fishing effort at this centre. The maximum catch (4321 tonnes) and catch rate (443 kg) were obtained by Pattenkolli. This catch rate during the year was higher than that of previous year, indicating an increase in fishing effort would have resulted in higher catches at this centre. While the Pattenkolli catches were supported by O–year class (42.2%) and 1–year class (37.3%), that of Mathi chala vala were contributed mainly by 1–year class (77.0%) and 2–year class (13.7%). Females were predominant in the catches. Fishes in advanced stages of maturity were abundant during the period May–August. Recruitment of Juveniles (modal size 85–90 mm) in the fishery was observed during August/October period.

At Mangalore a decrease in the oil sardine landings was witnessed, despite considerable increase in the purse seine fleet. Indigenous fishery also witnessed considerable decline in the landings and in activity as a result of the increased purse seine operations. The estimated catch during the year was 15,460 tonnes as compared with 17,390 tonnes of 1978. To the total landings, purse seine contributed 15,453 tonnes and the rest by the indigenous gear. Both at Ullal and Baikampadi, cast net was the principal gear employed in the indigenous fishery. The catch rate by purse seine during 1979 was 1255 kg as compared with 2710 kg in 1978. The fishery at Mangalore was mainly contributed by O–year class (88.2%) and 1–year class (8.1%). Adult fish in gravid condition were observed during May–August. As at other centres females were predominant. The entry of new recruits of Juveniles in good abundance was observed from September onwards.

The fishery at Karwar yielded an estimated catch of 2470 tonnes during the year as against 291 tonnes of previous year. This increase was mainly due to the purse seines, which contributed to 99.4% of the total in the current year. The catch by the indigenous gear however declined. The catch rates of purse seine and Rampani were in the order of 1629 kg and 70.2 kg res-

pectively. Unlike at other centres, males were predominant in the catches. Fish in advanced stages of maturity were abundant during May–September. The fishery was supported mainly by 0–year class (71.6%) and 2–year class (25.0%). The crecruitment of Juveniles into the fishery at Karwar was recorded both during January and September.

At Goa purse seine fishery landed an estimsed catch of 461 tonnes during 1979 with a catch rate of 245 kg. 0–year and 1–year age classes sustained the fishery

Evaluation of the resources of lesser sardines (FB/PR/1.3.1)

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The fishery for lesser sardines was moderate during the year. Compared with those of last year, the catches were considerably higher at most centres except at Madras and Mandapam. On the west coast a significant feature was the development of purse seine fishery for lesser sardines at the northern centres yielding an estimated catch of 1352 tonnes at Karwar and 1080 tonnes at Goa which is several times higher than the yield from the traditional fishery at these centres. *Sardinella fimbriata* and *S. dayi* were the predominant species in the purse seine fishery.

During the year investigations on lesser sardines were carried out at Madras, Mandapam Camp, Tuticorin, Vizhinjam, Karwar and Goa. At Madras the landings of lesser sardines were considerably lower during the year (39 tonnes) when compared to previous year (238 tonnes). Peak landings and catch rates were recorded during January and November. The fishery was mainly supported by *S. gibossa* (53%) and *S. dayi* (47%). The dominant sizes recorded in the landings were 110–165, mm for *S. gibbosa* and 135–160 mm for *S. dayi.* Sexes were equally distributed for both the species. Mature fish of *S. gibbosa* during April–June and of *S. dayi* during January–March and in November were predominant in the catches. Recruitment of Juveniles of both species was observed during December–March months.

At Mandapam Camp a marginal decrease in catches was observed during the year (102 tonnes) as against 147 tonnes in 1978. Improved catches from the Palk Bay and decreased land-

ings from the Gulf of Mannar characterised the fishery. While *S. gibbosa* contributed to the bulk of the landings from both the areas, *S. albella* was dominant in the gill net catches from Gulf of Mannar. The modal size of *S. gibbosa* ranged from 50 to 150 mm in the samples from Palk Bay and from 110 to 150 mm in the Gulf of Mannar.

Similar data for *S. albella* was in the order of 30–135 mm and 60–135 mm from the Palk Bay and Gulf of Mannar respectively. Good recruitment of Juveniles of *S. gibbosa* (50–75 mm) and *S. albella* (30–65 mm) in the catches from Palk Bay were observed from January onwards. Species like *S. davi.*

At Tuticorin considerable improvement in the fishery during the year was observed with an estimated catch of 3784 tonnes as against 2825 tonnes in 1978. Gill nets were the Principal gear employed. Highest catch (599 tonnes) and catch rate (122.4 kg) were recorded during December and in October respectively. *S. gibbosa* (30.4%), *S. dayi* (24.6%), and *S. sirm* (23.6%) dominated the catches at this centre. Other species that contributed marginally to the lesser sardine fishery were *S. albella* (5.8%) and *S. clupeoides* (0.3%). Among the predominant species, *S. gibbosa* with modal sizes at 135 mm and 170 mm contributed to the bulk of the catches. In this species females were predominant. Adult fish in gravid condition were recorded mainly during March–August and in spent condition during April–June. Because of the selectivity of the gear employed fishes smaller than 115 mm were not observed in the landings.

The lesser sardine landings at Vizhinjam during 1979 were 165 tonnes as against 293 tonnes in 1978. Gill nets and boat seines were the important gear employed in the fishery accounting for 79% and 17% of the catch with catch rates of 76.1 kg and 12.2 kg respectively.

S. gibbosa, S. sirm and *S. sindensis* were the dominant species accounting for 59%, 26% and 12% of the annual catch. The size range of *S. gibbosa* and *S. sirm* was 20–190 mm and 110–254 mm respectively in the samples measured. Males and females were in equal proportion in both the species. Fishes in advanced stages of maturity were recorded during September–November

for *S. gibbosa* and during December and February–March for *S. sirm.* Good adundance of Juveniles (20–50 mm) of *S. gibbosa* were recorded during January–February and in August.

The purse seine fishery at Karwar was very successful with an estimated catch of 1352 tonnes as against a meagre catch of about 3 tonnes by the indigenous gear during the year under report. While *S. gibbosa S. dayi* and *S. fimbriata* contributed to the bulk of the purse seine catch; *S. gibbosa* was the dominant species in the landings of indigenous units. A catch rate of 897 kg for the purse seine and 5.0 kg for Rampani were recorded. Highest catch (804 tonnes) and catch rate (5.7 tonnes') were obtained by the purse seine units during May. *S. gibbosa* with sizes at 120–160 mm, *S. dayi* with sizes at 125–155 mm and *S. fimbriata* with sizes at 100–120 mm, and 165–170 mm contributed to the bulk of the landings. Recruitment of Juveniles (modal size 80–95 mm) at Karwar were recorded during April and November for *S. fimbriata* and during September and November for *S. gibbosa.*

As at Karwar, purse seine fishery at Goa for lesser sardines was very productive with an estimated catch of 1080 tonnes and a catch rate of 549 kg. Highest catch (421 tonnes) and catch rate (996 kg) were obtained in December. The entire catch was contributed by *S. fimbriata.* Its size ranged from 70 mm to 195 mm with modes at 80–95 mm, 120–124 mm and 150 mm. Adults with advances stages of maturity were generally abundant during December–May p eiod. Very good recruitment of young fish (modal size 80–90 mm) to fishery was observed during August/ September.

Evaluation of the resources of anchovies (FB/PR/1.3.2)

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The anchovy fishery was mainly supported by the long-tail anchovy (*Coilia dussumieri*) at Bombay, the long-jaw anchovy (*Thryssa spp*) at Madras and Kakinada and the short-jaw anchovy (*Stolephorus spp.*) at Mangalore, Cochin, Vizhinjam, Mandapam and Waltair centres. At most centres the fishery was good ex-

cept at Vizhinjam and Mandapam. The decrease in anchovy catch during 1979 appears to be due to decrease in abundance of *S. devisi.*

Under the project, investigations on anchovies were strengthened during 1979 by starting the resources study at Mangalore and Kakinada besides the existing centres at Bombay, Cochin, Vizhinjam, Mandapam, Madras and Waltaire. At Bombay the catches of anchovies were 875 tonnes during the year. Of this total, 427 tonnes at Sasoon Docksand 448 tonnes at Versova were landed. Dol nets and trawl nets were the principal gear employed. The highest catch rate for trawl was 74.7 kg and for dol net was 56.5 kg. at Versova and 84.0 kg at sasoon docks. However, the Dol net landings at Sasoon Docks were relatively lower than at Versova where good landings were recorded during most part of the year. *Coilia dussumieri* formed the dominant constituent of the anchovy catch: the other species met with being *Stolephorus commersoni, Thryssa dussumieri* and *T. mystax. Coila dussumieri* in landings ranged between 50 mm and 196 mm in length. Fishes in stages IV and V of maturity were noted during January–February and October–December. Prawns formed dominant food item of the fish.

A total of 759 tonnes of *Stolephorus* was landed at Mangalore during 1979 accounting for the bulk of the anchovy catch of the area. Of this, purse seines accounted for 94.2% and the rest by trawls. About 75% of the purse seine catch was landed during October–December. Trawls landed *Stolephorus* only during May–June and November–December periods. Theree species namely *S. devisi* (66.5%), *S. macrops* (11.4%) and *S. bataviensis* (9.5%) contributed to the bulk of the catch. *S. devisi* and *S. bataviensis* were the dominant species caught by pruse seines and trawls respectively. Gravid and spent fish of the major species were abundant during October–December. Sexes were equally distributed except for *S. macrops* where males dominated.

At Cochin the anchovy fishery yielded an estimated catch of 356 tonnes. Of this catch *Stolephorus* contributed to 275 tonnes and the rest by long-jaw anchovy (*Thryssa*). Highest catch and catch rates for *Stolephorus* were registered during May/June and September/October periods. The bulk of the landings (98%)

was obtained in the shrimp trawls. Highest catch rates for *Thryssa* were obtained during March and November. The predominant species that contributed to *Stolephorus* fishery were *S. bataviensis* (48.0%), *S. heterolobus* (23.7%) and *S. macrops* (18.7%). While former two species were dominant during April/May and October/December; *S. macrops* was most abundant during June/July. Gravid fish of the dominant species were abundant during February/May and October/December. *S. heterolobus* with modal sizes at 60–65 mm and 75–85 mm, *S. bataviensis* with modes at 60–70 mm and 80–90 mm and *S. macrops* with a mode at 65 mm contributed to the fishery.

At Vizhinjam 68 tonnes of anchovies were landed of which *Stolephorus* accounted for 56 tonnes and the rest by *Thryssa.* A considerable decline in the *Stolephorus* fishery during the year as compared with earlier years was evident. This appears partly due to the decreased landings of *S. devisi* a dominant species in the area. Boat seine, shore seine and gill net accounted for 61%, 12% and 27% of the whitebait catch. Gill net recorded the highest catch rate (39.6 kg). In the catch predominant species were *S. devisi* (30%), *S. bataviensis* (51%) and *S. buccaneeri* (14%). In the catches of long-jaw anchovies, *Thryssa setrirostus* (77%) and *T. mystax* (19%) were the predominant species. They were caught mainly in gill net (Chalavala) and shore scienes. Among the whitebaits, fish with mature, partially spent and spent gonads were common during several months. Sexes were equal in most species excepting *S. bataviensis* and *S. buccaneeri* where females dominated. The predominant species of long-jaw anchovies in mature condition were recorded during December–March and supported the fishery during the period.

At Mandapam the total estimated catch of anchovies (*Stolephorus*) was 2.8 tonnes during the year compared to 5.4 tonnes in 1978. The catch was obtained by shore seines at Panaikulam (Palk Bay). Maximum catch and catch rate (8.5 kg) were recorded during July/August. *S. bataviensis* (44.7%), *S. devisi* (26.4%) and *S. indicus* (17.2%) were the dominant species in the landings. Here also as at Vizhinjam a decline in the catch of *S. devisi* was evident. Immature fish mostly contributed to the fishery. Early Juveniles of *S. bataviensis* (below 50 mm) were observed in the catch during April/June and September/

October. This species was found infested with a copepod parasite, *Larnaerius anchoviella* often with 7–8 parasites.

At Madras the fishery for anchovies yielded an estimated catch of 51.3 tonnes of which *Stolephorus* comprised 19.6 tonnes and *Thryssa* 31.7 tonnes. The latter was caught by gill nets while the former by trawls and shore seines. *S. heterolobus* during Februa ry–May and *S. bataviensis* during November–December were abundant. The size of the former ranged from 20 mm to 90 mm and the latter from 50 mm to 85 mm in the samples examined. Both the species with mature gonads were recorded generally during February–April and September–December. The catches of *Thryssa* were good in January, June and August. *T. dussumieri* was the predominant species followed by *T. mystax*. Length range of the *T. dusumieri* was 72–194 mm with dominant size at 105–124 mm. Juveniles of this species (85–99 mm) were recorded during August–October. Mature fish in stages IV and V were common from May to September.

At Kakinanda (Uppada) the anchovy fishery yielded an estimated catch of 61 tonnes during the year. The catch was composed of *Thryssa* (97.3%), *Stolephorus* (1.6%), *Setipinna* (0.9%), and *Coilia* (0.2%), shore scines landed the bulk of the catch (90.4%) at the rate of 223 kg per net. The rest of the catch was obtained by gill net and boat seines with a catch rate of 0.2 kg and 0.1 kg respectively. Dominant species were *Thryssa dussumieri* and *Stolephorus commersoni.*

At Waltair the total catch of anchovies was estimated at 385 tonnes of which 324 tonnes by trawl net and 61 tonnes by the indigenous gear. While *Stolephorus heterolobus, S. bataviensis* and *Thryssa mystax* were ithe main contributors to the landings by the indigenous gear; in the trawl catches *S. bataviensis, S. heterolobus. T. setirostris* were the dominant species. In the catches, the size of *S. heterolobus* and *S. bataviensis* ranged from 30 to 90 mm and from 35 to 85 mm respectively with modal size for both the species at 75–80 mm. The size of *T. mystax* caught by gill nets ranged from 160 to 210 mm. Males in *S. heterolobus* and females in *S. bataviensis* and *T. mystax* were significantly high. Whitebaits (*S. heterolobus & S. bataviensis*) with developing and mature gonads were recorded during August–December. *T.*

mystax in gravid condition were abundant during March/May and in December.

The Fishery and resources characteristics of the mackerel (FB/PR/2.1)

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The mackerel landings decreased during the year at most of the observation centres except at Karwar and Keelakarai. Purse-seining has commenced at Cochin also in the period under report. Around Mandapam the magnitude of the fishery was better on the Gulf of Mannar side than on the Palk Bay side. The decrease in the mackerel landings at Calicut was due to reduction in the recruitment. The cpue of Pattenkolli at this centre was only 34.65 kg in 1979 against 310.71 kg of last year. The catch as usual comprised mainly of 1-year old fish except at the northern sector of both the west and east coasts where the 0-year olds dominated. The growth studies during the year indicated an average monthly increase of 3 to 4 mm for the commercial size. Breeding, as indicated by the advancement of gonadial conditions, would have occurred during July-August and October-November.

Investigations on the fishery and biology of the mackerel were carried out at Goa, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Mandapam and Waltair.

At Goa the investigations were initiated in April and the landings by the purse-seine during April-December was 423 tonnes with an overall cpue of 198.21 kg. The catch comprised mainly of 0-year olds (59.16%). 1-year olds amounted to 40.75% and the rest was 2-year olds.

The landings by both the purse seine and Rampan at Karwar increased. The Ramapan landed 1096 tonnes (42%) and the purse seine landings was 1535 tonnes (58%). Nevertheless, the introduction of purse seine has considerably reduced the cpue of the Rampan net. The catch comprised mainly of 1-year old fish followed by the 2-year olds in good measure of abundance. The 0-years formed only a small part of the catch.

TABLE--6

The CPUE in number of the mackerel of different age groups at important centres of observations in the second half of 1978 & 1979

CENTRE AND GEAR	1978 AGE GROUPS				1979			
IN BRACKET	0	1	2	3	0	1	2	3
Keelakarai (drift net)	0	99	57	0	0	71	66	
Vizhinjam (boat seine)	18	14	0	0	17	0	0	0
Cochin (boat seine)	2	506	1	0	1	19	0	0
Calicut (boat seine)	48	1002	290	0	41	28	63	0
Baikampady (Rampan)	0	29418	0	0	20327	3308	0	0
Karwar (Rampan)	0	59231	135	0	155	41274	22145	0

Age group: 0–year 159 mm, 1–year 160–229 mm.
2–year 230–269 mm, 3–year 270 mm.

The purse seine landings of mackerel at Mangalore in 1979 was 6721 tonnes as against 9277 tonnes in 1978; this decrease is mainly due to the reduction in recruitment in September–December period. The Rampan landings at Baikampady reduced to 20 tonnes against 138 tonnes of last year. The catches comprised mainly of 1–year old fish followed by 2–year olds. The modal sizes in the commercial catches of the purse seines showed a growth from 215 mm in April to 235 mm in September and the rate of increase appears to be 4 mm per month. Fish in advanced stages of maturity were abundant in April–June.

At Calicut the landings fell to 697 tonnes in 1979 from 4029 tonnes of 1978. Pattenkolli was the main gear in operation and its cpue was 34.65 kg in 1979 against 310.71 kg of last year. The decrease in the landings here also was due to reduced recruitment. There was a growth of 4 mm per month here during January–August period. Among the new recruits the growth during July–December appeared to be 17.5 mm per month. Partly spent fish were recorded in the catches during June–September period.

At Cochin the Thangu vala catches in 1979 decreased to 193 tonnes from 396 tonnes of last year. The ayila vala landings however showed an increase to 194 tonnes from 126 tonnes of last year. There was a decrease in the number of Thangu vala units in operation and an increase in Ayila vala units. Purse-seining has started in Cochin this year. Beginning in September it has landed 49 tonnes of mackerel in the year. There was 155 tonnes landed by the drift nets and another 46 tonnes brought in by the trawlers. The 1–year old fish dominated the catches (87%) and the rest was 2–year olds. There was an average increase of 3 mm per month in the adult group of fish during January–June period. Among new recruits during July–November growth rate of 15 mm per month was recorded. From the advancement of maturity condition and from the occurrence of spawning and spent fish at Cochin, it was inferred that the spawning had occurred first in July–August and again in October. Feeding was observed to be moderate.

At Vizhinjam the mackerel landings during the year decreased to 91 tonnes from 135 tonnes of last year. Konchu vala and drift net were the main gears used. The fish ranged in size from 25 to 309 mm in the catches. Though the 0–year class was

well represented (44.2%) the 1-year olds dominated /46.1%). The 2-year olds formed 9.3% and the 3-year olds just 0.4%.

At Keelakarai the catch showed improvement, the respective figure in 1978 and 1979 being 27 and 90 tonnes. The landings at Pamban were 26 tonnes in 1979. The magnitude of the fishery was better in the Gulf of Mannar region whereas on the Palk Bay side it was not so encouraging.

At Waltair the total landings in 1979 was 5 tonnes by the indigenous units and 2.5 tonnes by the mechanised vessels. At this centre the 0-year olds dominated the catch with 53%, followed by 1-year olds 39% and 2-year olds 8%.

Resources of tunas and bill fishes (FB/PR/3.1)

E.G. SILAS, M.S. RAJAGOPALAN, P. PARAMESWARAN PILLAI, V. BALAN, M.D.K. KUTHALINGAM, P. LIVINGSTON, C. MUTHIAH, PON SIRAIMEETAN, S.S. SARMA AND P.M. ABOOBAKER

A significant improvement of 84.2% in the all India tuna catch during the year over that of last year was observed. Similar increasing trends in the catch was evident at most centres of observation except at Calicut and Vizhinjam. The introduction of small mechanised boats as well as nylon drift gill nets has contributed much to this increased landings. *Euthynnus affinis* in the peninsular waters and *Katsuwonus pelamis* in the Minicoy waters predominated the tuna catch. In the Malwan-Ratnagiri region *T. tonggol* appears to be more abundant species.

Regular monitoring of the resources was done at all the observation centres. Spot survey was conducted in the Mangalore-Ratnagiri sector during November/December to collect information on the operational and economic aspects of tuna fishery and on the biology of the species. Regionwise and country-wise catch data and of Japanese and Taiwanese longline data on tuna fishery (1965-78) from the Indian Ocean Region was studied. Longline fishery contributed to 58% in 1977 and 50% in 1978 to the total yellowfin (*Thunnus albacares*) landings which were about 63,000 tonnes in 1978. Rapid expansion of the surface fishery especially by Maldives, Oman, Tanzania, Sri Lanka and Yemen in recent years is evident.

At Tuticorin *E. affinis* and *A. thazard* were the main species contributing 60% and 26% respectively to the total estimated catch of 370 tonnes. *K. pelamis* during June–August and *T. albacares* during August–September were caught in good quantities. Drift gill nets landed about 99% of the total catch. June September was the most productive period. The size of *E. affinis* and *A. thazard* in the catches ranged from 310 to 745 mm and from 250 to 44 5 mm respectively. Among bill fishes, *I. platypterus* having size range of 1130–2675 mm was caught occasionally.

The catch at Vizhinjam during 1979 was estimated at 336 tonnes as compared with 397 tonnes of last year. Drift gill nets contributed to the bulk (75%) of the catch. Maximum catch and catch rate was recorded during October. *E. affinis, S. orientalis* and *A. thazard* were the principal species constituting about 54%, 28% and 15% of the catch. Bill fish (*I. platypterus*) catch amounted to 12 tonnes during the year.

At Cochin (Fishing Harbour), an estimated catch of 1235 tonnes of tuna was landed by Drift gill net/Pablo type boat units. Maximum catches were recorded during May and July months. The bulk of the catch was contributed by *E. affinis* (70%) and *A. thazard* (20%). Small quantities of *T. tonggol, T. albacares, A. rochei* and *S. orientalis* were also recorded. Bill fishes were represented by *I. platypterus* and *M. indica.* The size range of tunas and bill fishes landed are given in the Table. Juveniles of *E. affinis* (21 cm) and *S. orientalis* (11 cm) were recorded in September. Fluctuations in the price structure of different species of tuna were recorded.

TABLE--7

Size range and modal size (in cm) of tunas and bill fishes recorded at different centres during 1979

Species	Tuticorin	Vizhinjam	Cochin	Calicut	Mangalore	Ratnagiri
E. affinis	31–75*	31–73	21–71	—	24–70	46–68
	(33–67)**	—	(52)	(40–45–55)	(32–53–63)	(52–54)
A. thazard	25–46	31–59	33–48	—	—	—
	(34–43)	—	(40)	(20)		
A. rochei	—	22–36	—	—	—	—
	—	—	—	—	—	—
S. orientalis	—	48–62	11–52	—	30–36	—
	—	—	(36)	(40)	(34)	—
T. albacares	53–73	52–78	63–78	—	—	—
	(55–66)	—	(68)	—	—	—
T. tonggol	—	—	38–64	—	69–73	52–75
	—	—	(60)	(40)	(71)	(66–78)
K. pelamis	39–56	—	—	—	—	—
	(41–47)	—	—	—	—	—
I. platypterus	113–268	—	70–340	—	—	87–200
	(201)	—	(165)	—	—	(178)
M. indica	—	—	152–225	—	—	—
	—	—	—	—	—	—

* *Size range* ** *Modal size*

The estimated catch of 64 tonnes at Calicut during the year was less than that of last year. A notable feature in this region is that the drift net fishing was conducted by the canoes which are towed to and from the fishing ground by the mechanised boats. Relatively better catches were recorded during September-January. As at the southern centres, here also *E. affinis* was the rrincipal species contributing to 96% of the total tuna catch. Other species recorded were *A. thazard, T. tonggol* and *S. orientalis*. The predominant species with modal size between 40 and 55 cm contributed to the catch.

At Mangalore, out of the estimated tuna catch of 90 tonnes, purse seines landed about 82 tonnes and the rest by the drift nets which as at Calicut were operated from non-mechanised boats. *E. affinis* was the predominant species. *T. tonggol* contributed to about 2% of the drift net catch. *E. affinis* ranged in size from 240 to 300 mm in the purse seine catch and from 480 to 700 mm in the drift gill net catch. The size of *T. tonggol* and *S. orientalis* measured ranged from 690 to 730 mm and from 300 to 370 mm respectively.

The tuna landings at Goa were estimated at 51 tonnes. They were caught by purse seine at Panjim and by drift gill nets at Colva-Vasco region during September-October.

During the spot survey conducted during November-December 1979, it was observed that in the Malwan-Ratnagiri region mechanized satpati-type boats and Machuwas operate drift gill nets for tuna fishing. Fishing season is confined to September-November with peak during October. Total estimated tuna catch at the main landing centre at Ratnagiri was 310 tonnes of which *T. tonggol* fromed 60% and *E. affinis* and *A. thazard* together formed 40%. The size of *T. tonggol* ranged from 515 to 750 mm in length and 2.2 to 4.6 kg in weight. Few females (680-700 mm) were observed in spawning condition at Malwan. The size of *E. affinis* ranged from 470 to 680 mm in length and from 1.5 to 4.0 kg in weight.

Resources of seer fishes (FB/PR/3.3)

M.V. PAI, C. MUTHIAH, T.M. YOHANAN AND GRACY MATHEW

The fishery for seerfish at most of the centres of observation registered considerable improvement during 1979 compared to

that of last year. In order of abundance, king seer (*Scomberomorus commerson*) and spotted seer (*S. guttatus*) at Tuticorin, Calicut and Mangalore; the spotted seer, the king seer and streaked seer (*S. lineolatus*) at Karwar contributed to the bulk of the annual landings. The dominance of the spotted and the streaked seer in the fishery at the northern centre is noteworthy. Good recruitment of young ones (mode 28–32)cm was observed at Tuticorin during May–June.

The work on the resource characteristics of seer fishes was continued at Calicut, Mangalore and Karwar and was intitiated at Tuticoirn during the year. The seerfish catch was better during the year over that of last year at most centres of observation.

At Tuticorin the fishery was good with an estimated catch of 170 tonnes landed by Driftnets, Hooks and line and troll line. Drift net was the important gear accounting for 40% of the catch, followed by Hooks and line. Maxima in the catch and catch rates were recorded in September and December and in April and September respectively. *S. commerson* ranging in size from 23 to 148 cm and *S. guttatus* from 28 to 102 cm contributed to 73% and 22% respectively of the seerfish landings. Good recruitment of young fish (mode 28–32 cm) was recorded mainly during May–June.

At Calicut the fishery yielded an estimated catch of 127 tonnes in 1979 compared with 113 tonnes in 1978. As during earlier years, the drift net continued to be the principal gear which accounted for 99.5% of the landings. Maximum catch (39 tonnes) and catch rate (71.7 kg) by this gear was obtained in January. The fishery was supported by S. *commerson* (97%) and by *S. guttatus* (3%). Their size in the commercial catches ranged from 25 to 135 cm and from 30 to 55 cm respectively.

Compared to the other centres, the seerfish landings at Mangalore were higher during the year with an estimated catch of 525 tonnes. Here, as at other centres of observation, the principal gear employed was the drift net operated from the mechanized and non–mechanized craft. Of the total catch, mechanized units accounted for 75% and rest by the other units. Maximum catch (205 tonnes) and catch rate (109.3 kg) was obtained in November. The fishery, as at the southern centres, was mainly supported by

S. commerson (68%) and by *S. guttatus* (31%). The landing were mainly sustained by the year classes 1 to 3 of which 1-year class predominated for both species. The contribution made by 1, 2, 3-year classes respectively was in the order of 61.1, 32.7, and 6.1% for *S. commerson* and 82.1, 15.3 and 2.4% for *S. guttatus.*

At Karwar with an estimated catch of 517 tonnes in 1979 the fishery for seer fish was more productive than that in 1978 when 400 tonnes were landed. Of the total current year's production about 361 tonnes at Karwar and 156 tonnes at Gabitwada were landed. At Karwar both surface and bottom set gill nets were operated of which the former accounted for the maximum catch (259 tonnes) and the catch rate (53.4 kg). At Gabit wada drift net was the principal gear used. In the Karwar region maximum catch and catch rate was recorded during September and August respectively. The fishery was supported by *S. guttatus* (44.8%), *S. commerson* (34.8%) and by *S. lineolatus* (20.4%). While size of *S. guttatus* ranged from 30 to 101 cm, that of *S. commerson* varied from 34 to 117 cm. In *S. lineolatus* the size ranged from 30 to 98 cm. Here also, as at other observation centres, the fishery appears to be mainly supported by the 1 and 2-year classes.

Culture of anchovies as live-bait for tunas (FB/PR/3.4)

G. LUTHER, G. GOPAKUMAR AND MADAN MOHAN

Salient findings

A very low survival rate was observed among the species of *Stolephorus* stocked at densities of 1.3, 1.2, 0.45 and 0.05 thousand fish per cage and in proportion of S. *buccaneeri* 75%,*S. devisi* (15%) and *S. bataviensis* (10%) in all cases. After one month of stocking *S. buccaneeri* was alone found to be alive and at the end of three months its survival rate in the first and second cages was 23.1% and 16.7% respectively; while none survived in the others. Mortality during transportation was 36%. Anchovies caught in encircling nets were in better condtion than those caught by other gear for stocking and rearing. *S. buccaneeri* was found to be hardier than the other species.

The fishery and resource characteritics of Bombay duck (FB/PR/4.1)

S.V. BAPAT, V.M. DESHMUKH, ALEXANDER KURIEN AND M. ZAFFAR KHAN

The fishery for Bombay duck was more successful during the year compared to that of last year at most of the observation centres. While the maximum abundance of the species off Maharashtra coast was observed during September–October; it was recorded off Gujarat coast during October–November. Good recruitment of early juveniles (modal size 20–75 mm) at most of the contres during February–March and September–October was noteworthy.

Under the project, investigations on the Bombay duck (*Harpodon nehereus*) at Bombay (Versova and Arnala) and at Veraval (Nawabunder, Rajpara and Jaffrabad) were carried out during the year under review. At Bombay the fishery yielded an estimated total catch of 6,132 tonnes during the year and was comparatively better than that of last year. Out of this total, 4,735 tonnes at Arnala and 1,347 tonnes at Versova were landed. Dol net was the principal gear employed. Highest catch rate of 193 kg at Versova and 355 kg at Arnala was recorded during September and October respectively. The dominant modal sizes in the fishery ranged from 60 to 280 mm at Versova and from 20 to 280 mm at Arnala. Males predominated the catches. The size at first maturity (for both male and females at 50% level) was 230 mm. The species was found feeding actively on *Acetes indicus, Palacmon tenuipis, Colia dussumieri* and its own young ones. The recruitment of early juveniles in good abundance was recorded at Arnala mainly during May/June and October/ December.

At Veraval, the total catch for Bombay duck was estimated at 32,318 tonnes which was significantly higher than that of last year. Out of this total, 5,640 tonnes at Nawabunder, 14,870 tonnes at Rajpara and 11,808 tonnes at Jaffrabad were landed. At all these centres Dol net was the principal gear employed. The highest catch rates at the above three centers was recorded during November (602 kg/haul), October (224 kg/haul) and October (262 kg/haul) respectively. The fishery was mainly supported by modal sizes ranging from 50 to 275 mm at Nawabunder,

from 35 to 270 mm at Rajpara and from 50 to 260 mm at Jaffrabad. Male and female fish were in equal proportion in the samples examined. Fish with gravid gonads were generally abundant in the catches during February-April andSeptember–December. Good recruitment of Juveniles was boserved at all the centres over a number of months.

Fishery and Resource characteristics of Carangids (FB/PR/5.1)

S. REUBEN, V. SRIRAMACHANDRA MURTHY,
T. PRABHAKARAN NAIR AND VINAY D. DESHMUKH

Carangid fisheries at Watair, Kakinada and Bombay were good during the year except at Vizhinjam where a decrease in catch was observed. *Decapterus dayi* and *Megalaspis cordyla* at Waltair and Vizhinjam, *D. dayi* at Kakinada and *M. cordyla* and *Atropus atropus* at Bombay were the dominant species contributing to the fisheries. Maximum abundance at Waltair and Kakinada during February/April and September/October, at Vizhinjam during January/February and September/November was observed.

Work on Carangids was carried out at Waltair, Kakinada, Vizhinjam and Bombay. At Waltair an estimated catch of 30 tonnes from the Lawson's Bay landing centre and 30 tonnes from the E.F.P. trawlers was recorded. They formed 6.1% and 22.5% of the total landings by the indigenous gear and the trawls. The fishery was mainly contributed by *D. dayi* and *M. cordyla*. Besides trawl, boat–seine and Hooks and line were the main gear employed in the fishery. Maximum catch rates were generally recorded during February–April and September–October. *M. cordyla,* ranging in size from 21 to 44 cm with modal size at 26–29 cm. and 37–39 cm, contrbiuted to the catch during November/December.

At Kakinada work was started in March. At this centre an estimated 949 tonnes of Carangids were landed by shrimp trawlers and formed 10.1% of the total fish catch. *D. dayi* was the most dominant species and contributed to 93% of the Carangid catch. Peak catches were landed during February–March and September months. Biological characteristics of *D. dayi* were studied. The species with modal sizes at 125–135 mm and 155–185 mm contributed to the fishery. Males predominated. Fishes with advanced stages were recorded during March–April.

Young fish with modal size at 95 mm were recruited to the fishery in May and continued to support the fishery in the subsequent months. Its growth pattern was studied. Fishes with full and half full stomach were observed during March, May and December.

At Vizhinjam Carangid landings were estimated at 559 tonnes which formed 9.6% of the total fish landings. When compared to the catches of last year the present landings declined by 50%. Of the gear employed in the fishery Drift net and Hooks line contributed to the bulk of the landings. The Carangid fishery at this centre was supported mainly by *D. dayi* (55.3%) and *M. cordyla* (9.1%). Peaks of abundance were recorded during January–February and September–November *M. cordyla* ranging in size from 105 to 399 mm contributed to the landings. Good recruitment of Juveniles (105–145 mm) was recorded during July August. Among the adult fish, females were dominant. Fish in developing and spent condition were observed during January March and September December. The Maxima in the feeding activity were recorded during September/October and December/ February months. The stomach contents comprised mainly of the juveniles of *Leiognathus, Stolephorus* and sardines.

The work on Carangids at Bombay was initiated during the year. At this centre an estimated catch of 170 tonnes were landed at Sasoon docks during July–September months. The bulk of the catch was landed by the trawlers. Maximum catch and catch rate were recorded during September. *M. cordyla* and *Atropus atropus* were the predominant species in the landings.

The resource characteristics of ribbon fishes (FB/PR/5.2)

P.T. MEENAKSHISUNDARAM, Y. APPANNASASTRY,
S. LAZARUS AND S.K. CHAKRABORTY

A significant increase in the landings of ribbon fishes at all the centres of observation during 1979 was the noteworthy feaure. Peak abundance of the resource at Kakinada during February/March and June/July, at Madras during May/June and December/January, at Vizhinjam in August and at Bombay during February/April and October/December was evident. *T. lepturus* was the principal species supporting the ribbon fish fish eries at most centres, except at Bombay where *T. muticus* was the dominant species in the Dol net catches.

Studies on the resource characteristics of ribbon fishes were continued at all the observation centres. At Kakinada the fishery with an estimated catch of 1414 tonnes during 1979 was better than that of last year. Its contribution was 25.9% in the annual fish landings. Mechanised trawl was the gear employed. Good abundance was observed during February–March and June July, *T. lepturus* (72.0%), *L. savala* (12.7%) and *T. russelli* (6.1%) with size range at 181–750, 271–570 and 211–540 mm respectively contributed to the bulk of the catch. Recruitment of Juveniles (181 mm) was recorded during April/May and in October.

The estimated catch at Madras was 185 tonnes; of which 85 tonnes by the mechanized trawl and 100 tonnes by the indigenous gear were landed at Kasimode and Triplicane landing centres. The maximum catch and catch rate by the trawl during May/June and December/January and by the indigenous gear during July–August was recorded. With modal sizes ranging from 200 to 749 mm *L. lepturus* was the principal species in the landings. Fishes with gravid gonads were observed in most of the months. Early Juveniles (140–185 mm) were recruited to the fishery during June, August and November months.

The fishery for ribbon fishes at Vizhinjam landed on estimated catch of 3429 tonnes forming about 58.7% of the total fish landings in 1979. Heavy landings were recorded during June October with peak in August. Though several indigenous gear were employed in the fishery, boat seine (Thattumadi) was the most successful gear contributing to 94.8% of the annual catch and with a catch rate of 388.1 kg. As at the other centres, here also *T. lepturus* ranging in size from 41 to 1120 mm and with dominant modal sizes at 70, 210, 550, 650, 750 and 850 mm contributed to the catch. Adult fish with developing and spent condition were observed during June–November months. Good recruitment of Juveniles (80–100 mm) to the fishery during July August was evident at this centre.

Observations at regular intervals at Bombay (Sasoon docks Kasara Bunder and Versova landing centres) were made. The total estimated ribbon fish catch was 2,029 tonnes of which 769 tonnes at Kasara Bunder, 860 tonnes at Sasoon docks and 400 tonnes at Versova were landed. Trawls at the former and trawls

and Dol nets at the latter centres were employed. While the contribution made by trawls was 1537 tonnes; Dol nets landed 492 tonnes. Good abundance in the local waters was recorded during April, August and December months. While the highest catch rate for the trawl was recorded in December (87.4 kg) at Kasara bunder, in August (72.8 kg) at Sasoon docks; for the Dol net it was observed in June (98.7 kg) at Versova and in October (38.6 kg) at Sasoon docks. At Sasoon docks the trawl landings consisted exclusively of *T. lepturus* and the Dol net landings by *E. muticus* (60%), *T. savala* (20%) and by *T. lepturus* (20%). At Versova *E. muticus* was the most dominant species contributing to 80–85% of the fishery, followed by *T. lepturus* and *T. savala*. Of the two predominant species, *T. lepturus* and *T. muticus* with sizes ranging from 191 to 1335 mm and from 110 to 700 mm respectively contributed to the landings.

The Fishery and resource characteristics of sharks (FB/PR/5.3)

M.D. KUTHALINGAM, P. DEVADOSS, K.S. SUNDARAM,
M. MOHAMED KASIM, S. BASHEERUDDIN, P. NATARAJAN,
M.E. RAJAPANDIAN, S.K. BALAKUMAR AND S.G. VINCENT

The shark fishery at Bombay was comparatively better than at all other centres. The landings at Veraval during March–December was 431 tonnes. The hooks and line fishery at Elathur (near Calicut) from the grounds in 40–50 fathoms was encouraging and landed good catches.

The investigations on the fishery and resource characteristics of sharks at Veraval were initiated in March only. The total catch during March–December period landed by trawl nets and gill nets was 431 tonnes forming 3.15% of the local marine fish landings. *Scoliodon palasorrah* ranging in size from 35 to 80 cm and *S. sorrakowah* ranging in size from 20 to 65 cm were represented in the landings.

The total landings at Bombay was estimated 1339 tonnes of which 611 tonnes were landed at Kasarabundar by trawlers at a cpue of 32.1 kg. At Sasoon dock the landings were 728 tonnes of which 85.3% was caught by trawlers at a cpue of 37.0 kg, 14% by gill net at a cpue of 43.6 kg and rest by hooks and line and dol net. The operation of dol net was confined to the.

first half of the year. *Scoliodon sorrakowah* and *Carcharinus spp.* were the main components in the catches. *Sphyrna blochii* was present in July. The fishery of *S. sorrakowah* was supported mainly by 0–year and 1–year groups. The size in the trawl landings was found to range from 120 to 900 mm. The species appear to breed after the monsoon period and was found to give birth to 3 or 4 young ones during September–December.

At Calicut the estimated landing of the sharks was 99 tonnes. Drift net contributed to the maximum catch followed by hooks and line and Ayilachalavala. *Carcharinus* spp. formed the bulk of the catch (77%). They were mainly represented by *C. limbatus, C. sorrah, C. melanoptera* and *C. dussumieri.* The rest of the catch was contributed by *Sphyrna lewini* (16.6%), *Scoliodon laticaudus* (6.0%) and by *Hypoprion macloti* (03%). The fishing by hooks and lines in 40–50 fathoms off Elathur (near Calicut) landed 91 tonnes of sharks consisting mainly of *C. limbatus, C. sorrah, S. lewini* and *Rhizoprionodon* spp. The size composition of *S. laticaudus* in the catch was recorded. Recruitment of this species in large numbers was observed from November to January. Females of *Scoliodon* in pregnant condition were recorded over an extended period. Females outnumbered males in all the months except during premonsoon period. Mating appears to take place during the active monsoon months, food consisted of prawns, crabs, *squilla,* squids and fishes.

The catch at Tuticorin was estimated to be 96 tonnes landed by longlines. The dominant species present were *Rhizoprionodon acutus, Hemigaleus* spp. and *Loxodon macrorhinus.*

At Madras the work was initiated in July 1979. The landing centres at Pudumanaikuppam/Kasimedu and Nochikuppam were covered biweekly. The total estimated catch of sharks at Pudumanaikuppam/Kasimedu and Nochikuppam was 41 tonnes. While at the former Trawl and gill nets and at the latter hooks and line were the main gear used from mechanized and non-mechanized crafts respectively. Highest catch rate (131.1 kg) was recorded by the Gill net units. Trawl, gill net and Hooks and line contributed to 27.7%, 55.8% and 16.5% of the total shark landings. *Scoliodon palasorrah* formed the main stay of the fishery contributing 65.4% of the catch. The other species represented in the landings were *S. sorrakowah, Eulamia melano-*

ptera, Sphynna tudes and *S. blochii.* In the landings, the size of *S. sorrakowah* was 39–60 cm and that of *E. melanoptera* was 30–34 cm. In both the species males were predominant. The food of *S. sorrakowah* consisted of fish (50%), Cephalopods (25%) and prawns (25%).

Resource characteristics of Pomfrets (FB/PR/5.4)

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Comparative studies on the landings of Pomfret fishery at different centres of observation during the year indicated greater abundance of the resource at the northern centres than at the southern centres on the west coast. The predominance of white pomfret (*Pampus argenteus*) at Veraval, Bombay and Puri and the black Pomfret (*Parastromateus niger*) at Cochin and Vizhinjam was noteworhty. Good recruitment of early juveniles of white pomfret off Gujarat (Nawabunder) and off Bombay (Versova) coast was evident.

The work programme on the pomfret resources was continued at Veraval and Cochin and initiated at Bombay, Vizhinjam and Puri during the year.

At Veraval investigations could be resumed from October onwards only. The pomfret fishery at Veraval and Nawabunder landing centres was studied. During the fourth quater an estimated catch of 674 tonnes at Veraval and 17 tonnes at Nawabunder was obtained. Trawl and Drift gill nets at the former and bag net at the latter centre were the principal gear employed. Maximum catch and catch rate were obtained by the trawl. *P. argenteus* was the predominant species in the landings. Its size in the drift net catch varied from 141 to 310 mm with dominant modes at 171–180, 201–220 and 251–260 mm. The bag net landings at Nawabunder comprised of younger fish ranging in size from 31 to 120 mm. Good recruitment of early juveniles was observed during October–December months.

Work at Bombay was initiated during 1979. An estimated pomfret catch of 433 tonnes at Satpati by Drift gill nets during September–December and 34 tonnes at Versova by Dol nets during October–December was recorded. The highest catch (164 tonnes) and catch rate (617 kg) by the drift net and by Dol net

(17.8 tonnes and 11.1. kg) were observed in September and November respectively. The fishery was mainly sustained by *P. argenteus*. The size of the species in the Dol net catch ranged from 30 to 235 mm with dominant size at 111–145 mm and in the Drift net from 181 to 295 mm with dominant modes at 191–200 mm and 251–270 mm. Abundance of juveniles (30–90 mm) were generally observed during March–September period.

The pomfret fishery at Cochin during the year landed an estimated catch of 184 tonnes when compared with 398 tonnes in 1978. Drift gill net and trawl were the main gear employed. Drift nets contributed to 97.6% of the total catch. While the maximum catch was landed by the Drift nets during the fourth quarter, highest catch rate was recorded during the first quarter. The fishery was mainly supported by *P. niger* (99.7%) and *P. argenteus* (0.3%). The white pomfret was caught mainly by the trawl. The former species ranging in size from 150 to 510 mm and the latter one from 140 to 340 mm contributed to the pomfret fishery. Sex–ratio was equal in the predominant species. Fish with gravid gonads were abundant during March–July and spent fish during February/March and July/October months. Males were found to mature at an earlier age than females. Early juveniles (60–115 mm) of white pomfret (*P. argenteus*) were recorded in good abundance during February/March. The food of *P. niger* consisted of Copepods, *Lucifer*, other Crustaceans and salpa. The rate of growth of the predominant species was also studied.

At Puri where the work was started during the year, the fishery for pomfrets was estimated to land 18.9 tonnes mostly by the indigenous gear. Bottom set gill net was the gear used. The fishing season lasted from February to October with peak landings during the third quarter. As at the centres on the North west coast, here also *P. argenteus* contributed to the fishery. The species ranging in size from 100 to 300 mm and with dominant sizes at 120–190 mm and 200–260 mm supported the fishery. Males during the first half and females during the second half of the year were dominant in the catches. The size at first maturity was 24 cm. The spawning season was observed to be from March to August with peak during April/June. Smaller fish ranging in size from 120–160 mm were predominant during

the third quarter. Salps, amphipods, copepods, ostracods, larval crustaceans, *Acetes* and hydromedusae formed the dominant components in the stomach contents.

Unit stocks of oil sardine, mackerel and Bombay duck (FB/PR/6.1)

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Investigations on the deliniation of unit stocks of oil sardine, mackerel and Bombay duck by electrophoresis could not be initiated for want of a biochemist at Mangalore, equipment and chemicals at Karwar and power supply at Bombay. The associate at Karwar visited Mangalore to acquaint himself with the working procedure of the equipment and the use of chemicals and to take them with him to Karwar to carry out the work.

Evaluation of the distribution and abundance of spawners and young fish (FB/PR/7.1)

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Among the pelagic fish there appears to be two peak breeding periods; once during premonsoon months and again during post monsoon period for most of the species studied. This is evident from the recruitment pattern of Juveniles of the species also at most of the observation centres. The abudnance of Juveniles of *D. russelli, R. kanagurta* and *S. longiceps* at Mangalore; *C. kalla, P. argenteus, L. lactarius* and *S. longiceps* at Cochin and *S. longiceps, Sardinella* spp., *Stolephorus* spp., *Sphyracna* spp., *Caranx* spp., *D. russelli* and *T. lepturus* at Vizhinjam was noteworthy.

The work programme under this Project was intiatied during 1979 at Mangalore, Cochin Vizhinjam and Madras. During the year an estimated 26.34 tonnes of young fish were landed at Vizhinjam. Boat seines and shore seines were the principal gear employed, contributing to 67% and 33% of the landings with an average cpue of 0.37 kg and 4.91 kg respectively. In the total catch pelagic component formed 46.8% and the rest by the demersal species. Although the occurrence of young fish of the pelagic group was observed over several months, peak catch rates were recorded during February (0.30 kg), August (0.23 kg) and

December (0.79 kg). The catch was constituted mainly by *Sardinella longiceps* (7.43%), *Sardinella* spp. (8.5%), *Rastrelliger kanagurta* (0.3%), *Stolephorus* devisi (1.2%), *S. bataviensis* (1.1%), *S. buccaneeri* (4.9%), mullets (2.0%), *Sphyraena* sp. (8.7%), *Caranx* spp. (4.2%), *Decapterus russelli* (1.0%) and *Trichiurus lepturus* (4.3%). The abundance of these species was observed generally during February/April, July/August and October/December. Juveniles of *Stolephorus* spp. ranging in modal sizes from 35 to 45 mm, *Sardinella* spp. from 25 to 84 mm, mullet from 40 to 59 mm, mackerel from 35 to 64 mm, *Sphyraena* spp. from 40 to 135 mm and *T. lepturus* from 76 to 200 mm were recorded in the catch. Their index of abundance (Number/Boat seine day) in 1979 was in the order of 239, 51, 355, 3, 9 and 65 resepctively. Mature and spent fish of *S. devisi, S. bataviensis, S. buccaneeri* and *S. indicus* were more abundant generally during March/June and October/December months. The index of abundance of mature and spent fish during the year for these species was in the order of 119, 15, 18 and 1 respectively.

At Cochin young fish were recorded mainly in shrimp trawlers. During the year an estimated catch of 42.2 tonnes was landed by the trawl. Maximum catch rates were recorded in March and July. The component of pelagic species was in the order of 91.5% of the total catch. Among the pelagic species, *Pampus argenteus* (5.0%), *Caranx kalla* (85.1%), *Lactarius lactarius* (6.9%), *Caranx kurra* (1.4%), and *Thryssa mystax* (1.6%) were the main contributors. The index of abundance (No/trawl day) of Juveniles for the above species during the year was in the order of 17, 104, 134, 78, and 21. *P. argenteus* with size ranging from 60 to 135 mm, *C. kalla* from 70 to 115 mm, *L. lactarius* from 50 to 90 mm. contributed to the young fish landings. Mature fish of *Stolephorus* spp. and black pomfert (*P. niger*) during March/May and October/November and *Thryssa* spp. during November were observed in greater abundance than in other months. The index of abundance of mature fish of *Stolephorus* spp., *Thryssa* spp. and *P. niger* was in the order of 1412, 431 and 37 respectively.

Sizeable quantities of Juveniles and of mature fish of oil sardine (*S. longiceps*) were also caught at Cochin in Thanguvala and Purse seine. Juveniles ranging in size from 75 to 100 mm were recorded during August–October and the mature fish dur-

ing April–September. The index of abundance (No/Thanguvala Day) during 1979 for the Juveniles and the nature fish was estimated at 558 and 267 respectively.

At Mangalore an estimated catch of 20.4 tonnes of young fish was caught by purse seine and cast net. The former gear accounted for 90.3% of the catch. Young fish were generally recorded during August–November with highest abundance in September. The young fish landings were comprised of *Decapterus russelli* (80.9%), *Sardinella longiceps* (13.5%) and *Rastrelliger kanagurta* (5.6%). The index of abundance (No/purse seine day) for the above three species during the year was in the order of 1265, 61 and 68 respectively. Mature fish of *S. longiceps* during April–October with a peak in June and of *R. kanagurta* during March–October with a peak during June/Septembr were observed. Their index of abundance was estimated to be 7993 and 2798 respectively.

Among the pelagic species, *Thryssa dussumieri* in mature condition (stage IV & V) occured in good quantities off Madras from May to September with a peak during July/August. *Stolephorus heterolobus* in gravid condition was recorded in greater abundance during February–April and in lesser abundance in September–December. In *S. batavieniss,* however, mature fish were observed during September–December. While the mature fish of *Sardinella dayi* were in good abundance in January–March and in November; that of *S. gibbosa* were recorded from April to June.

b) Demersal resources

The fishery and resource characteristics of cat fishes (FB/DR/1.1.1)

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1. At Waltair as against a catch of 8484 kg (7.4 kg/U; 8.9%) of cat-fish realised during last year in the off shore regions, during the current year a catch of 11,211 kg (7.5 kg/U; 14.9%) of cat-fish was recorded. In the inshore regions also the corresponding catches were 57.616 kg (1.1 kg/U; 10.3%) during the year as against a catch of 30,455 kg (0.6 kg/U; 6.1%) during last year.

There was thus an improvement in the cat-fish fisheries during the current year in both the off shore/inshore regions. In both the regions the fisheries were supported by two species *T. thalassinus* and *T. tenuispinis*. While the improvement in the catches in the offshore regions was due to increased catches of both the species; in the inshore regions it was due solely to improved catches of *T. thalassinus*. *T. tenuispinis* in fact recorded a decline.

A sample of 1671 specimens of *T. thalassinus* ranging in sizes from 110 to 519 mm were measured. Two modes at 200 and 360 mm were predominant. The catches composed mainly of immature groups of fishes completing one year of age. Feeding intensity was more during November and the dominant food items were crabs, *Squilla* and fish.

A sample of 1411 specimens of *T. tenuispinis* ranging in sizes from 103 to 449 mm was measured. Principally three modes at 170, 210 and 420 mm were noticed. The fishery was supported mainly by immature groups with a modal length of 220 mm. The dominant food items were polychaetes, fish and molluscs.

2. At Madras while an estimated catch of 5938 kg cat-fish was landed by the mechanised boats at the Pudumanikuppam landings centre; the E.F.P. trawlers landed a catch of 1064 kg only. In the mechanised boats, *T. thalassinus*, *T. tenuispinis*, *T. dussumieri* and *T. jella* supported the cat-fish fisheries with respective contributions of 31.5%, 23.6%, 22.8% and 22.1%. *T. thalassinus* ranged in sizes from 200 to 450 mm with modes in length groups of 20–24 cm; 30–34 cm, and 40–44 cm. Since observations of cat-fish from indigenous crafts were initiated late in the year, no conclusions could be arrived at on the status of the fishery in the inshore regions.

3. At Calicut an estimated catch of 631 tonnes of cat-fish was landed where the chief gears of operation for cat-fish were drift net, hooks and line and trawl net which respectively contributed estimated catches of 169,344 and 118 tonnes of cat-fish. The fisheries were supported chiefly by four species viz., *T. tha lassinus T. tenuispinis T. serratus* and *T. dussumieri* which was the chief contributor in all the gears with a contribution of 25.9%.

4. At Veraval the estimated total catch by all the units was 504 tonnes comprising a catch of 396 tonnes by trawl nets

and 108 tonnes by the gill nets. While the gill nets were productive in September and October; the trawl nets were from October to December. Among the 7 species that occurred in the catches, the dominant species were *A. dussumieri* and *A. tenuispinis* (31%). A total of 312 specimens of *A. tenuispinis* was measured for length frequency studies. Both the trawler catches and gill net catches there was a declining trend in the mean size through the month of September to December.

Resource characteristics of perches (FB/DR/1.1.2)

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At Bombay regular observations of the catches were made at Kasara Bunder and Sassoon Docks where mainly mechanised vessels operate. The catch particulars of perches as well as of all fish were observed. Samples were collected for biological studies.

During the year under report, 136,497 kgs of perches were landed at Kasara Bunder by mechanised vessels operating trawl nets. Perches occurred only during the months January, September, October, November and December. *Lutianus sanguineus Pomadasys hasta* were the two main species. Highest landing was in November.

At Sassoon Docks, 30651.5 kg of perches were landed by mechanised vessels operating trawl nets and also from hooks and lines. 74.5% of the total quantity of perches landed were caught during November; with a catch per unit of 15.38 kgs. Hooks and lines landed only 2712 kgs of perches during the months of February and March.

In the case of *Lutianus sanguineus* the common size group in June was 150–190 mm; in September 155–180 mm and 250–290 mm were the common size groups observed. From October to December 200 to 240 mm and 350 to 390 mm size groups were prominent. *Pomadasys hasta:* The common size groups present in the trawl net catches during September were 150 to 190 mm and 350–390 mm; 300–340 mm and 450–490 mm were common in November and December respectively.

At Vizhinjam, a total quantity of 169.967 kgs of perches were landed during the year. Perches formed 3.78% of the total

fish catch. *Nemipterids* (29.68%) *Lethrinids* (20.21%) *Lutianids* (18.91%), *Theraponids* (15.34%), *Serranids* (6.87%) Ambassids (5.37%) were present in the order of their abundance. Hooks and lines (71.18%) was the most important gear followed by drift nets (14.61%) boat seines (6.67%) Shore seines as well as Konchu vala and Nandu vala (both gill nets) contributed a smaller quantity of the perch catch. Lutianids, Theraponids and Nemipterids dominated the catch during 1st, 2nd and 3rd quarters respectively. Hooks and lines were operated throughout the year.

Nemipterus bleekeri, N. mesoprion and *M. delagoae were* taken up for biological studies as these were available in good numbers. *N. bleekeri* ranged in size between 31 mm and 275 mm and the weight was from 20 gms to 225 gms. Fish between stages I and IV were present. *N. mesoprion:* Size range was from 110 to 290 mm and mean wieght 113.97 mm. Fish between stages I and IV were present. Fishes of stages II to stage VII were present. 38 species of perches were collected and identified.

At Tuticorin, a total quantity of 259.997 kgs of perches were mated to have been landed forming. 4.72% of the total fish estilanded here during the year. Both indegenous crafts and gears as well as mechanised trawlers operated off Tuticorin.

The major gears employed in perch fishing were hooks and lines (72%) and drift nets (26%). An inconspicuous quantity was caught by other gears like shore seines, lobster nets (sinki valai). The mechanised trawlers of the Govt. of India Ex'ploratory Fisheries Project operated off Tuticorin landing 48,143 kgs (18.5%) of perches during the year.

Lethrinids 104,099 kgs (49.14%) was the most important species landed throughout the year; Serranids 42,586 kgs (20.1%) forming the next major group. The other important groups of perches landed during the period were lutianids, (5.8%) caught by hooks and lines throughout the year and Nemipterids (15.24%) which occurred only seasonally in the months of January and February and September to December. A considerable quantity (8.6%) of fishes belonging to family Plectorhynchidae also landed during the year.

The average catch per unit during the first quarter was 9.05 kgs, while in the second and third quarters it is on the increase: 17.11 kgs and 32.96 kgs respectively. During the fourth quarter again a slack was observed in the catch per unit being 22.00 kgs.

Lutianus lineolatus was taken for detailed biological studies. Samples were collected once a week and analysed for length-weight, sex, maturity stages, growth etc. During the first quarter samples were available only in January and March with two modes at 147 mm and 170 mm. In the second quarter samples were available only during the month of June with mode at 165 mm. 70% of the population were female fishes, stages II and III were dominating in both males as well as females. Samples of *L. lineolatus* were not available during July. In August and September, the population constituted mainly immature and stage I groups ranging in size from 110 to 140 mm. The species practically did not appear in the catches during the last quarter but for their occurrence during the first week of November with 30% of the fish being immature. Females dominated and stages I to III were observed.

At Tuticorin, perch trap fishing operations were conducted from the Exploratory Fisheries Project vessel, M.V. Jheenga at a depth of 35 metres. Collapsible traps were operated using cuttle fish, sardines etc. as bait. Traps were hauled after an hour. No perches were trapped in them. As the vessel was sent for repairs and dry docking, no further experiments could be carried out.

Resource characteristics of threadfin breams (FB/DR/1.1.3)

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The landings of threadfin breams by commercial trawlers at Kakinada showed a decrease of 31% over 1978, though there was an increase of 4.3% in the effort expended. The catch per unit of effort also declined. An estimated 271 tonnes of these fishes were landed at Kakinada. At Madras an estimated 96 tonnes of Nemipterid fishes were landed by the trawlers. At Cochin, an estimated 2748 tonnes of these fishes were landed.

Four species: *N. japonicus, N. mesoprion, N. tolu* and *N. luteus* contributed to the fishery at Kakinada; of these *N. japonicus* dominated forming 72% of the nemipterid catches. At Madras also four species occurred: *N. japonicus N. tolu, N. luteus* and *N. delagoae*. Here also *N. japonicus* dominated forming 49% of Nemipterid catches. At Cochin and Bombay, it is reported, 100% of the catches were formed by *N. japonicus* only.

At Kakinada peak landings were obtained during first and last quarters. At Madras better returns were obtained during 2nd and 3rd quarters. Peak landings were obtained during the third quarter at Cochin.

A bulk of the catches of *N. japonicus* at Kakinada belonged to 'O' and 1 age groups; smaller fishes forming modes at 55.65 or 85 mm occurred during January, February, May, July, September and December. At Madras the length range (on the basis of the data collected during July–September and December) was rather narrow extending from 95 to 215 mm only. At Cochin fishes above 105 mm only occurred in the catches (at this centre data were collected only during June–November period).

Females of *N. japonicus* attain first maturity at a length of 125 mm and the spawning season is a prolonged one and extend from August to April at Kakinada. Males out number females in almost all months and above the length of 220 mm all are males only.

At Madras gravid females occurred during July–September and December (no data during January, February, October and November). At this centre also males outnumbered females in almost all months.

At Cochin gravid females occurred during August–November period. Data are not available for the period January–May 1979. (At this centre females outnumbered males in almost all months (the situation at Kakinada and Madras is con trary to this).

Sciaenid resources of the east and west coast of India (FB/DR/1.2)

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At Waltair the sciaenid catch from the Government of India trawlers operating from Waltair coast was analysed. The total catch of sciaenids from M.V.Meenashodhak was 2518.1 kg, which constitued 7.3% of total catch; the cpue of sciaenids was 3.45 kg. *Johnius carutta* and *Pennahia macropthalmus* formed 51.9 and 7.4% of the sciaenid catch, respectively.

The total sciaenid catch from M.V. Meena Jawhar was 2241.7 kg which constituted 5.2% of total catch; the CPUE of sciaenids was 2.92 kg. *J. carutta* and *P. macropthalmus* formed 36.3 and 22.7% of scieanid catch, respectively. M.V. Matyashikari had a comparatively poor catch of sciaenids; the catch was 192 kg, which formed 0.3% of total catch. *J. carutta* formed 42.7% and *P. macropthalmus* 57.3% of sciaenid catch in M.V. Matyashikari.

At Kakinada an estimated 697.5 tonnes of sciaenids were landed by the trawlers in Kakinada forming 7.5% of the total trawl catches. The catch per unit of effort varied from a minimum of 5.8 kg in January to a maximum of 28.3 kg in August and averaged 13.0 kg. Of the 17 species that occurred during this period, *Atrobucca nibe* (29.8% of sciaenid catch) *J. carutta* (14.9%), *P. macropthalmus* (10.8% of sciaenid catch) *J. dussumieri* (8.6%) and *Kathala axillaris* (8.5%) dominated the catch.

Biological studies were carried out in *J. carutta.* The length of *J. carutta* from trawl catches in Kakinada coast ranged from 90 to 219 mm during different months of the year. Of the 179 fishes analysed for sex ratio and maturation stages, 55.3% were females. Mature and ripe females occurred in May and from September to December; stage II females were present in the catch.

At Madras an estimated 140 tonnes of sciaenids were landed from mechanised trawlers of Pudumanikuppam landing centre, forming 11.0% of the total trawl catch. The CPUE varied from

a minimum of 1.5 kg in August to a maximum of 53.6 kg in January and averaged 12.9 kg. Of the 15 species that occurred during this period, *J. aneus* (22.7%) of sciaenid catch. *Otolithus argenteus* (21.7%)' *J. carutta* (17.4%), *Johnieops sina* (10.7%) and *Nibae maculata* (6.1%) dominated the catch.

Biological studies were carried out on *J. aneus, O. argenteus* and *J. carutta.* The length of *J. aneus* varied from 70 to 240 mm, that of *O. argenteus* from 75 to 270, and J. carutta from 80 to 200 mm during different months of the year. Of the 190 *J. aneus* analysed, 44% were females and stage I to IV were present in the catch. In *O. argenteus* and *J. carutta* 72 and 40% were females respectively and matured stage V individuals were present.

Sciaenid catch from 3 landings centres operating non-mechanised vessels were estimated from July, 1979. Average monthly Sciaenid catches were 6 (0.01%) of total catch), 420 (1.82%) and (195 (1.90%) kg in Pudumanikuppam, Triplicane and Nochikuppam landing centres, respectively.

The estimated landing of sciaenids from trawlers at Vellayil, Calicut was 220.2 tonnes. The CPUE varied from a minimum of 6.6 kg in February to a maximum of 64.7 kg in January and averaged 27.6 kg. Of the 9 species that occurred during this period, *O. ruber* (48.8% of sciaenid catch) and *J. sina* (41.6%) dominated the catch.

Biological studies were carried out in *J. sina* and *O. ruber.* The length of *J. sina* from Vellayil trawl catch ranged from 35 to 195 mm and that of *O. ruber* from 35 to 305 mm during different months of the year. In *J. sina* 54% of the individuals examined were females and in *O. ruber* 58.5% were females. The percentage of mature *J. sina* was observed to be higher in January, February, April, May and August. In the case of *O. ruber,* individuals in very early stages of maturity dominated the catch.

The sciaenid catch from trawlers at Beypore landing centre was estimated for 5 months from January to May. During these months, the catch was 211.9 tonnes and the CPUE averaged 24 kg. The length of *J. sina* from Beypore trawl ranged from 35 to 185 mm and that of *O. ruber* from 45 ot 285 mm during

these 5 months. In *J. sina* 56.1% of the individuals examined were females and in *O. ruber* 51.4% were females. In the case of *J. sina* most of the individuals examined were mature whereas most of *O. ruber* were immature.

During monsoon from June to September, 15,509 kg of sciaenids were landed in Vellayil centre from Mathichala vala, Ayilachalavala and Pattenkolli vala also.

At Bombay the fishery and biology of sciaenids and ghol *Psuedosciaena diacanthus*) were studied from the data and samples collected from the mechanised trawlers operating from Kasara Bunder and Sassoon Docks. The scieanid landing at Kasara Bunder was 1739.8 tonnes; the CPUE varied from 29.6 kg in April to 280.8 kg in December and averaged 84.7 kg. The ghol landing was 270 tonnes and the CPUE varied from 3.5 kg in January to 23.8 kg in June, with an average of 13.1 kg. In Sassoon Docks, the estimated landing of sciaenids was 1887.6 tonnes; the CPUE varied from 16.0 kg in August to 244.4 kg in December and averaged 125.7 kg.

Of the 12 species that occurred in Kasara Bunder, *J. vogleri* (24.4% of sciaenid catch), *O. cuvieri* (21.5%) and *J. macrorhynus* (18.5%) dominated the sciaenid catch. In Sassoon Docks, 13 species were available, *J. vogleri* (24.7%), *J. macrorhynus* (21.1%) and *O. ruber* (21.0%) formed the major catch.

Biological studies on these three dominant species were carried out. The length of *J. macrorhynus* ranged from 105 to 289 mm during different months of the year. Of the 780 individuals analysed, 43.5% were females, 43.9% were males and the remaining 12.6% were immature. The length of *J. vogleri* ranged from 125 to 370 mm; female constitute 37.4%, male 49.1% and the immature 13.5% in the 548 specimen examined. *O. cuvieri* ranged from 121 to 279 mm to total length. Female formed 44.8%, male 51.2% and the immature 4.0% in the 127 fishes examined. Most of the specimen in these 3 species were in a maturing stage. Fecundity study was also carried out in *J. vogleri, D. cuvieri, J. sina* and *J. dussumieri.*

Stomach contents of 536 *J. macrocryhnus* were studied. The stomach of 78.5% of these fishes were empty and for 16.0% fishes, the stomach was full. Percentage composition of foop

in 106 specimen was estimated. *Squilla, Acetes, crab* and *Solenocera* were found to be the major food of *J. macrorhynus.*

The fishery and resources characteristics of silver bellies (FB/DR/1.3)

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A marked increase from the corresponding period last year in the total catch and CPUE of silver bellies by both night and day fishing from the Palk bay and Gulf of mannar sides off Mandapam was noticed. From the palk Bay side of Mandapam an estimated catch of 1201.77 tonnes (513.6 tonnes by day fishing and 688.2 tonnes by night fishing) were obtained, the respective CPUE being 433.79 kgs and 98.72 kg. Increased landing of 3534.82 tonnes with CPUE of 158.14 kg. from Rameswaram and 495.65 tonnes with CPUE of 89.34 kg from Pamban (Gulf of Mannar) areas were registered. *L. jonesi* was the dominant species in Palk Bay and the trend of its fishery was similar to that observed for silver bellies as a whole. In Madras the trawl catches showed a declining trend, the catch amounting to only 27.76 tonnes with CPUE of 9.36 kg as against 85.6 tonnes and 15.2 kgs obtained during the corresponding quarter last year. The deeline was probably due to decreased effort. *L. bindus* was dominant in February and March whereas *L. splendens* dominated the catch in January. In Kakinada an estimated 178.0 tonnes of silver bellies were landed forming 6.4% of the total catch. *Secutor insidiator* and *L. bindus* were dominant in February and March respectively. In Karwar *L. bindus* appears to be the dominant species.

L. jonesi with modal range 45 to 65 mm and 80–90 mm, the former belonging to 0–year class and the latter to 1–year class formed the fishery in the size range of 30 to 120 mm from Palk Bay side of Mandapam. Mature fish in stage IV and above formed high percentage in all the months especially in February and March showing peak spawning activity during these months. Males and females formed equal proportions. From Palk Bay side of Rameswaram the modal categories were 40–60 mm and 75–90 mm in the size range of 25 to 110 mm.

Modal position of *L. dussumieri* fell into two categories viz. 90–105 mm and 115–130 mm in the size range of 75–160 in the Gulf of Mannar side. Mature fish dominated the catches.

In the trawl catches of Madras *L. bindus* ranged from 55–115 mm the modal groups being 60–69 mm, 70–74 mm and 90–94 mm the first two groups belonging to less than one year and the third to more than one year class. Mature fish were abundant in January and March while maturing fish dominated in February.

The size range of *L. bindus* in the trawl catch of Kakinada was 25–97 mm in February and March, the 35–39 mm and 55–59 mm groups being dominant in February and 30–34 mm 55–59 mm groups in March. Immature fish in stage II dominated the catches.

Evaluation of the demersal resources (of some selected centres) (FB/DR/1.4)

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At Bombay data from the exploratory cruises of the EFP Vessels, Meena Bharati, Meena Sangrahak and Meena Prapi were analysed. Of these, Meena Prapi operated only in June–September, while Meena Sangrahak did not operate in July–August. The log-sheets for the last quarter have not been received in full. Individually Meena Bharati fished in 17–100 m depth, catching mainly elasmobranchs, cat-fish and dhoma. The higher catch rates (105.59–142.98 kg/h) were in January–February. Sub-area 18–71/3C gave the highest return (1300 kg/h) in February from depth 84 m. M. Sangrahak caught mainly elasmobranchs, ghol, Karkara, dhoma and cat-fish, the highest catch-rate being from area 18–71 in the second quarter (96.6 kg/h) Meena Prapi brought the maximum return of 118.82 kg/h in June and 109.03 in September catching mainly dhoma and elasmobranchs.

At Cochin, the vessels of the IFP (Velameen, Samudra Devi, Norind 2 and Tuna) and the EFP (Meena Sachatak and Meena Utpadak) trawled, mostly in the inshore areas of 8–76, 9–76, 10–75 and 10–76, for the first three quarters (the log–sheets for the last being not yet available). The EFP vessel Velameen alone made two trips to the deeper areas (280–320 m) in February –March to catch prawns and lobsters. Also IFP operated traps in areas 9–75 and 10–75 in January–February to land 3747 kg of perches. For the rest the inshore catches were mainly of elasmobranchs, cat–fish and Nemipterus.

Catch and effort data collected from the operations of private trawlers gave an estimated landing of 11390 tonnes at a catch rate of 43 kg/h. Prawns formed nearly 30% of the catch, other sizeable component groups being Nemipterus and sciaenids.

At Tuticorin, of the three vessels operated during the year, MFV Jheenga put in the least trawling hours being laid up with engine trouble for most of the time and being diverted to some experimental trap–fishing in June–July (which was not quite successful). So for the year it landed 5.4 tonnes of fish at 41.9 kg/h. Meena Niryantak caught 57.8 tonnes at 111.9 kg/h. The maximum catch rate came from 7–78/3C (217.5 kg/h). Meena Saudagar, fishing throughout the year, caught 81 tonnes at 115.63 kg/h. For this vessel, too the highest catch–per–hour (120.8) was obtained from 8–78/3C. Together an estimated total of 144.5 tonnes was caught by the three vessels during the year in 1349 hours, the catch rate working out to 106.3 kg/h. Only 24 m trawl was used. Mostly perches, rays perchlets were caught. Prawns and lobsters were not.

At Mandapam as the vessel Cadalmin II was under repair, the experimental fishing survey could not be continued during the first half of the year. A survey of the private trawlers based at Mandapam was initiated during the year towards the close of the first quarter. From this an estimated catch of 14038 tonnes of fish was landed during the year at a catch rate of 29.34 kg/h (of which 3760 tonnes at the rate of 26.16 kg/h were from the Gulf and 10278 tonnes at the rate of 30.70 kg/h were caught from Palk Bay.)

At Madras, two EFP vessels fished during the year, Meena Gaveshak for nine months and Meena Sitara for eleven months. There were no operations in May. The two vessels together caught 49 tonnes of fish in 857 hours at the rate of 57.44 kg/h, which is quite low as compared to the previous year's catch. The best return of 134.10 kg/h came from 13-80/1C in July and the lowest 0.09 kg/h from 13-80/2C in November. The catch consisted mainly of silver-bellies, gerrids, sciaenids and lizard fish. Biological data on the more important species of silver bellies, sciaenids, lizard fish and *Nemipterus* were collected.

At Kakinada, an estimated total of 9353 tonnes of fish was caught by the three types of trawlers conducting daily fishing at depths of 10-60 m off Kakinada, in 400736 hours, the catch rate working out to 23.34 kg/h. The total showed a 11% increase over previous year's, as also the catch rate, *Decapterus* catches showed an 8-fold increase during this year, while the catches of *Nemipterus,* lizard fish and Bombay-duck showed decline of 31,45 and 88% respectively.

At Waltair two EFP vessels, Meena Shodhak and Meena Jawahar fished from Visakhapatnam base for the whole year, landing 75,018 kg at the rate of 50.3 kg/h, while a new vessel Meena Shikari (H.O. 1740) operated from May onwards landing 81,372 kg at 177.6 kg/h). While the total catch for the year, as compared to previous year (95,704 kg) was more, the catch rate this year 72.9 kg/h was less than last year's 83.7 kg/h). Group-wise the 'misc-big' and cat-fish dominated the landings, and the maximum catches were in January-March June and October.

Detailed studies on the fishery and biology of sciaenids, *Lactarius, Upeneus* spp., *Psenes* and *Polynemus* were continued.

Resources characteristics of rays and skates (FB/DR/1.6)

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At Vizhinjam the total catch of Rays was 23871 kg and *Hemantura bleekeri* formed the bulk of the catch. *Gymnura poecilura*

gymnura macrura. H. alcocki H. uarnak, Amphotistus imbricatus, A. kuhli, Dasyatis sephen, Rhinoptera javanica, Aetobatis narinari were also represented in the catch. Skate formed 3818 kg and they were mainly represented by *Rhynchobatus djiddensis, R. granulatus.*

At Tuticorin the estimated total catch of ray was 24295 kg. They were represented by *Himantura bleekeri, H. alcocki, Dasyatis sephen, Aetobatis narinari, Rhinoptera javanica.* The estimated catch of skates was 14310 kg. They were represented by *Rhinobates djiddensis* and *Rhina ancylostoma.*

At Calicut drift net and mechanised boats landed rays (11323 kg) They were represented by *Dasyatis uarnak, D. sephen* and *Aetobatis narinari. Aetobatus narinari* is found to feed on bivalves and teleostean fishes. Sex ratio was 47.37 male and 52.63 females in the catch.

The fishery and resource characteristics of lizard fishes (FB/DR/1.7)

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The estimated annual catch of lizard fishes at Kakinada, Madas, Mandapam Camp, Vizhinjam, Cochin and Calicut were 231.7, 48.6, 70.1, 19.4, 416.8 and 6.0 tonnes respectively. *Saurida tumbil* was the dominant species except at Madras, where *S. undosqunamis* was the major species. *S. elongata* formed a minor fishery at Cochin. At Vizhinjam hook and lines was the main gear while in other centres they were caught in trawlers. Females outnumbered males most of the period. Mature specimens were encountered at Cochin. Food items consisted of fishes, prawns and squids.

Culture of marine fishes (FB/CUL/1.1.1)

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At Waltair studies on the catch composition and abundance of the fishes and prawns of the Bheemunipatnam backwaters were continued till June 1979. *Liza macrolepis* and *Valamugil* sp. among mullets and *Metapeneus dobsoni* and *Penaeus indicus* among prawns were important.

L. macrolepis was the dominant species encountered in the catches during February (38.0%) May(46.4%) and June (38.5%). *L. macrolepis* was not caught during January. The length of the fish measured for length frequency studies ranged from 40 mm to 190 mm.

Valamugil sp. formed an important component of the fish catch during February (29.0%) March (26.0%) and June (29.1%). This species was not landed during January and April. The length of the fish measured ranged from 40 mm to 114 mm.

Mugil cephalus was represented in the catches in moderate quantities i.e., 11.8% in April and 9.6% in May. *Metapenaeus dobsoni* (65.7%) were reported in April followed by moderate quantities in May (7.4%) and June (18.6%). The length of the species ranged from 20 mm to 79 mm.

Penaeus indicus was landed throughout the period i.e. January–June with peaks in January (39.0%) March (29.0%) and May (13.1%). There was a single mode in each month. The mode at 37 mm in January can be traced to 62 mm in May showing a growth of 25 mm in 4 months. There appeared to be continuous recruitment into the fishery in all the months. i.e. January, June. The size of the species ranged from 25 mm to 89 mm.

At Mandapam Camp experimental fin fish culture was conducted in five cages.

Two species of rabbit fishes, namely *Siganus canaliculatus park S. javas* Linnaeus were reared in cages. For *S. canaliculatus* the average growth increment per month was 8.5 mm and 3.1 g and for *S. javas* average growth increment per month was 6.2 mm and 2.0 g in the one and 5.6 and 3.4 g in the other cage.

Two species of groupers, namely *Epinephelus tauvina* (Forskal) and *E. heragonatus* (Forster) were stocked in palmyrah leaf stalk cage (1.5 x 1.0 x 1.0m). The stocking density rate was about 13 nos/sq. m. and these were fed with chopped fish. After six months the size of *E. tauvina* ranged from 279.0 to 450.0 mm. (405.0 g to 1497.0 g) whereas *E. heragonatus* has not shown any consistent increase in size. In *Sillago sihama*, stocked in G.I. wire cage, the average growth increment per month was 10.0 mm and 1.6 g from July to September.

During the period under report the culture of fin fishes such as mullets, *Chanos*, *Sillago* and prawns were tried in polyculture experiment in fish ponds as well as in the 'pen' made of palmyrah leaf stalk.

An average monthly growth and weight increase shown by these species were 10.8 mm (5.6 g). 14.4 mm ('5.6 g), 18.85 mm (7.6 g), 14.1 mm (3g) for *L macrolepis*, *P. seheli*, *Chanos and P. indicus* respectively.

Another pond was stocked with *V seheli, chanos* and *Sillago sihama* at the stocking rate of 750 each/350 m^2. The monthly average size and weight increase recorded for these species were 12.9 mm (1.3g) 18 , 17.9 mm (5.8 g) and 10.3 mm (1.8 g) respectively. Thus they showed an average monthly size and body weight increase of 24.6 mm (6.2 g) for *V. seheli* and 30.1 mm (12.1 g) for *Chanos chanos*. Since the sea at Palk Bay side became rough after October, the pen culture experiment was completed by October.

It is seen from these three sets of experiment that the growth of mullets and chanos shown in the pen was better than in the ponds. Apart from the artificial food available in the pond and pen, supplementary food such as rice bran and ground nut oil cake were also tried in equal proportion in the form of paste.

At Tuticorin experiments on the culture of fin fishes like mullets and milk fish were carried out in marine fish farm deve loped at the tidal flats of Tuticorin Bay.

Seeds of milkfish were collected from the backwaters of Tiruchendur, Valinokkam and Arassaladi creek. Mullet seeds were obtained from mud holes in Tuticorin Bay. All the seeds were acclimatised in happas and only active groups alone were released.

Preliminary experiments were carried out in fish farm of salt pan reservoir for polyculture of *Chanos chanos, Mugil cephalus* and *Penaeus indicus*. The seeds stocked during April–May 1978 were reared and harvested on 17–3–1979.

In *P. indicus* estimated average growth upto 83 mm size was 16.3/mm/month. Till it reached 123 mm the growth rate was 10.7 mm/m and very much low afterwards. *M. cephalus* exhibited a fast growth rate, 27.8 mm/month till it attained the size of 122 mm. Beyond that size the growth rate was 12 mm only. *C. chanos* revealed a still faster growth in the beginning. Upto 90 mm size the milk fish grow at the rate of 34.5 mm/m and declined to 29.5 mm/m to reach to a size 200 mm and then it was poor.

At Narakkal pond culture of mullet (*Liza macrolepis*) Pearlspot (*Etroplus suratensis*) and milk fish (*Chanos chanos*) was attempted in a 0.02 ha area pond. Stocking of fish was done at the rate of 100 nos. (5,000/ha) of mullet, 100 nos. (5000/ha) of pearlspot and 13 nos. (650/ha) of Milkfish during the first week of May 1979. However, the Milkfish was stocked during June and July also.

The initial and final size ranges and mean lengths of the three species during the period 3–5–79 to 13–12–1979 were: mullet: 73–225 (132) to 194–219 (206.6): pearl spot of 30–88 (62) to 125–155 (145) milkfish: 148–410 (311–25) to 160–425 (249–25) mm. From May 1979 to December 1979 the temperature varied from 25.53°C to 35 C and the salinity was between 2.30 and 23.54‰. The oxygen value ranged from 2.86 to 9.34 ml/1.

50 nos. of pearlspot juveniles ranging 82 to 109 mm in length (95.42 mm mean length) and 14.0 to 26.50 gms in weight (19.87 gms mean weight) were tried for culture experiment in a 15' x 4'

dia. plastic pool feeding with 1:1 ratio mixture of groundnut oilcake and rice bran mixture feed fed at the rate of 5% of the body weight. An average growth of 4.38 mm in length and 6.17 mm in weight was observed for 15 days. The experiment was discontinued.

Milkfish fry ranging 10–13 mm in length were collected from Puthuvypu area (Vypeen Island) during the 3rd week of June 1979. They were reared for a period of 14 days in the plastic pool feeding with rotifer, copepod nauplii, copepodites and copepods and *Artemia* nauplii. A food preference study feeding with rotifers (*Brachionus* sp), copepod nauplii, copepodites and copepods was attempted and it was observed milkfish fry preferred copepod nauplii, than rotifers and the last copepodites and copepods. A linear relationship between food concentration and consumption was observed. Experiment with *Artemia* nauplii also showed similar relationship. The survival rate was 100% in these experiments. Subsequently the fry were reared feeding with 1:1 ratio mixture of groundnut oilcake and rice bran mixture powder for a period of two months (upto 30–8–1979). They attained a mean size of 44.60 mm in length and 0.94 gms in weight. The survival rate was 58%.

The fingerlings (396 nos) were stocked in a 0.02 ha area pond after the eradication of unwanted fishes using Mahua oilcake (@ 300 kg/ha) at the rate of 19,800/ha on 30–8–1979. Subsequently (on 12–10–1979) 150 fishes were transferred to another pond for polyculture experiment after which the stocking density was 12,300/ha. An increase in length of 87.72 mm/42 days (2.09 m/day i.e. 62.66 mm/month) in the first month and 36.23 mm/28 days (1.29 mm/day i.e. 38.70 mm/month) in the second month after stocking was observed. However, there was no increase in size in the third month. It is felt the available food in the pond might not have been sufficient. Hence it is proposed to give supplementary feeding in the coming months.

The temperature varied from 31.0 to 32.5°C and the salinity value was between 2.36 and 10.6‰. The oxygen ranged from 1.71 to 6.16 ml 0_2/l from September 1979 to December 1979.

Polyculture of Prawn (*Penaeus indicus*), Milkfish (*Chanos chanos*) and pearlspot (*Etroplus suratensis*) was also attempted in a 0.05 ha area pond. The stocking density of the prawn (*P. indicus*) was 3,024 (60.680/ha) that of milkfish was 149 nos. (2980/ha) and the pearlspot 60 nos. (1320/ha). The experiment was started on 12-10-1979 and was monitored for growth studies periodically.

An increase of 115.02 mm/72 days was observed in the case of milk fish. Most of the prawn became soft during the 1st week of December (when mode is 81.85 mm) and hence partial harvesting of prawn was resorted to. However, the milkfish and the other prawns were allowed to grow. The temperature of the culture pond varied from 31°C to 33°C and the salinity was between 2.36 and 16.37%. The oxygen value ranged from 2.28 to 10.52 ml /1 from October 1979 to December 1979.

At Calicut the following species were cultured: *Fishes* (1) *Liza subviridis* (2) *Mugil parsia* (3) *Lates calcarifer* (4) *Megalops cyprinoides* (5) *Chanos chanos* (6) *Etroplus suratensis.*

Prawns: (1) *Penaeus indicus* (2) *Metapenaeus dobsoni* (3) *Metapenaeus monoceros*

Mugil subviridis were found to grow to an average length of 232 mm (range 215–264 mm) weighing 116 mm during a period of 9 months. The length at stocking was 18–20 mm. The rate of survival was about 95%. The stocking rate was 5,500/hect. along with prawns at a rate of 50,000/hect. The production rate was found to be 250 kg/hect of fishes.

Mugil parsia is a slow growing species. It was found to attain a length of 130 mm weighing 21 gm during a period of 9 months. The survival rate was 95 at level of stocking 5500/hect. along with prawns stocked at the rate of 5,000/hect. The production rate was 250 kg/hect. of fishes.

Lates calcarifer attained 355 mm weighing 530 gm from 12-5-78 to 17-9-79. The rate of stocking was 1000/hect along with *Mugil* sp. numbering 5000/hect. It is interesting to observe that the *Mugil* spp cultured along with *Lates calcarifer* did not

show any sign of predation by the later. It is contrary to the earlier observations that *Lates* cannot be cultured with *Mugil* spp. The production rate of this species was found to be 500 kg/hect.

Megalops cyprinoides were stocked at the rate of 6250/hect. 125 specimens were stocked in 0.02 hect. pond. They attained 161 mm weighing 7.3 gm). The production rate was 275 kg/hect. in four months. They were fed with 1/10 of its body weight of pealed prawn heads.

Chanos chanos grow to 357 mm weighing 453 gm from 28–3–79 to 16–11–79 (stocking size 15–20 mm). The rate of stocking was 1350/hect. (27 numbers in 0.02 hect. pond). The production rate was 750 kg/hect for 8 months. The pond was not given any artificial food. But the stock subsisted on natural growth of the algae.

Etroplus suratensis of length 30–50 mm x –37 mm) weighing 0.4 to 3 gm were stocked in a pond of area 0.02 hect. at the rate of 6500/hect. They were stocked on 26–11–79. In one month they have grown to 55.7 mm (50–80 mm range) weighing 5.1 gm each.

Panaeus indicus was stocked along with other herbivorous species of fishes and also reared on monoculture.

On 3–5–1979 they were stocked at the rate of 56000/hect. They grew to 115 mm weighing 11.5 gm in 2–12–79. The stocking size was 19–23 mm. Rate of production was 250 kg/hect. for 8 months. The stock was fed with broken rice boiled with 100 gm of prawn head and 100 gm of sardine oil at the rate of 1/10 of the body weight of the stock.

In another experiment 2000 numbers of post-larvae (6–7 mm) from the surf were collected and stocked in a pond of 0.02 hect. area at the rate of 100000/hect. The stocking date was 28–3–79. They attained 115 mm weighing 11.4 gm on 17-11–79. During the monsoon (11–10–79) about 50% died due to low salinity and oxygen depletion. Production rate was 340 kg/hect. The prawns were fed with the pealed prawn heads at the rate of 1/10 of the body weight of the stock.

One 0.1 hect. pond was stocked with 7900 numbers of *P. indicus* on 8–12–79.

M. dobsoni attained 87 mm (85–99 mm) weighing 5.5 gm during a period of 8 months, from 22–1–1979 to 8–10–79 at the stocking rate of 13450/hect. The stocking size was 40 mm. When harvested after 8 months the survival rate was 26.3%.

Metapenaeus monoceros also attained more or less the same length as *M. dobsoni.* During 8 months it has grown to 87 mm weighing 5.8 gm.

Along with the studies on growth, survival and stocking rate, plankton and hydrological features of the ponds were also observed. Salinity, temperature and dissolved oxygen of the ponds were analysed weekly. The temperature was found to vary between 24°C to 41°C dissolved oxygen. 62 to 10.2 ml/1 and salinity 27 to 56.5‰.

At Mangalore culture of *Sillago* was continued during this year also. A bamboo pen was erected in the Mulky fish farm covering an area of about 182 sq. m. into which 827 fingerlings of *Sillago* (50–60 mm) were released in December '78 and January '79. A trial fishing was conducted in early February when a few numbers of these were netted and were again released in the pen. They did not shown any appreciable growth.

The final fishing was carried out on 16–6–79. No *Sillago* could be recovered. However, during low tide it was observed that considerable amount of erosion had taken place due to tidal actions at the bottom of the pen, thus throwing open wide gaps through which fish had escaped.

Induced breeding experiments were also conducted at Coondapur. On one occasion (September) a *Sillago* readily released eggs. The eggs could not be fertilized because of emaciated male.

Aquaculture of finfishes—Culture of eels. (FB/CUL/1.2)

R. SOUNDARARAJAN, D. KANDASWAMI

Mandapam:

The experiment on culture of eels in recycling water which was started in August 1978 was concluded in January. In six month period the total weight of the eels had increased from 9 to 43 kg. The average individual weight had increased from 43.0 g to 232.8 g. During the six month period the survival rate was 97.1% of the initial stocking. The production rate works out to 2.16 kg/sq.m./six month.

In a second experiment started in February about 770 young eels with individual weights ranging from 6.0 g to 30.0 g. (average weight 14.0 g) and with a total weight of 9 kg were released in the culture tank. The stocking density rate was 500 g/sq. m. the same as it was in the previous experiment. At the end of December the average individual weight was 63.6 g showing only a little increase. The estimated total weight was 20.7 kg; 327 eels survived and the survival rate was 65.4% of the initial number. In this experiment only old stock of elvers had been stocked. There might have been excess ammonia in the soil of culture tank, as the same culture tank has been used without removing the upper soil, and this might have possibly affected the growth of eels to a large extent.

In another experiment, the growth of elvers at different stocking densities was studied. For this purpose the elvers which showed stunted growth and also freshly caught elvers were stocked in different densities. All the elvers were given a mixed food of fishmeal, ground nut oil cake and broken rice mixed in 2:1:1 ratio.

In this experiment it has been found that in the initial 3 months there has been increase in weight in initial stocking densities of 500 g/sq. m. to 700 g/sq.m. and above that density there was no weight increase. However, in subsequent months there was decrease in total weight of the elvers in all the tanks. The increase in average individual weight was more in the stocking densities of 500 g/sq.m to 600 g/sq.m. In the densities of 500 g/sq.m to 600 g/sq.m the survival rate was about 75% while in densities of 700 g/sq.m to 800 g/sq.m it was 53% only.

In subsequent experiments freshly caught elvers were stocked at the following rates, 400 g/sq.m, 800/gsq.m '1200 g/sq.m and 1500 g/sq.m.

The increase in total weight and also in average individual weight was higher at stocking densities of 500 g/sq.m to 800 g/sq.m than in other stocking densities. The survival rate ranged between 59.5% to 73.4% of the initial stocking and the survival rate was more in lesser stocking densities than in higher stocking densities.

In both the experiments fluctuations had been found in weight increase and weight decrease has been found in later months. This may probably due to the fact that elvers have not fed well on the feed with the combination of fish meal, ground nut oilcake and broken rice. However, in overall analysis it has been found that the stocking rates between 500 g/sq.m and 800 g/sq. m may give better production than any other stocking rates.

Feeding experiments were conducted with different artificial feeds prepared with materials like fish meal, rice bran, ground nut oil cake, tapioca, black gram husk, cotton seed etc. mixed in different proportions. Elvers of average individual weights 0.67 to 0.75 g., in tank were fed with a particular feed of about 20% of their body weight. The feeds were made into a paste using 2% agar-agar solution. In this experiment the weight of the elvers decreased instead of increase. The weight decrease was negligible in eels which were fed with a feed with high percentage of fish meal; decrease in weight was greater when feed contained high percentage of brocken rice and cotton seed.

In another experiment three more artificial feeds were prepared using the materials namely fish meal, ground nut oil cake, tapioca, starmin, yeast and multi-vitamin tablets, mixing them in different proportions.

In about one month period the total weight had increased from 104 to 110.0 g in one tank and from 105 to 115.0 g in tank C while the total weight had decreased in tank B from 10 to 96.0

g. The elvers in tank A had consumed 688.0 g of dry feed, those in tank B 764.0 g and in tank C 645.0 g.

The gross conversion ratio of all the feeds had been very poor. The experiment has shown that the feed consumption has been more when feed contains more starch material and it is less when fish meal and oil cake are more in the feed. The experiment has also shown that the weight of the eel may decrease when there is more percentage of starch material.

Bio–chemical analysis of cultured eel was made. The moisture content was 63%. In dry weight the protein was 54.6% fat 40.0%, carbohydrate 3.3% and as content 2.2%.

Elver resources survey: The centres around Mandapam in which the elvers had been observed to migrate during the previous seasons, were visited from September onwards to observe the commencement of glass eel immigration in fresh water pools and the magnitude of immigration.

From third week of October there had been some heavy showers of rain daily and all the sea side pools in different centres had started to get filled with rain water flowing in from surrounding areas. However, no glass eels/elvers had immigrated into this pool also. By fourth week of October many of the pools had established connection to the sea and rain water was flowing into the sea. The glass eel migration was noticed for the first time in the season on 29–10–79 at Vedalai. Above 350 elvers (90% glass eels and 10% pigmented elvers) were collected on that day which weighed about 40 g. During November and December good migration of glass eels was noticed only on two occasions. once between last week of October and first week of November and another occasion during third week of December. During the other period mainly collections comprised pigmented elvers with very few glass eels. At the end of December fresh water flow to the sea from sea side pools ceased and there was no glass eel/elver migration into these pools.

Mariculture—culture of finfishes. Breeding, seed productions and culture of grey mullets (FB/CUL/1.1.3)

P.S.B.R. JAMES, G. MOHAN RAJ, A. RAJU,
V.S. RENGASWAMY AND L. KRISHNAN

Mandapam:

During the 3rd quarter a total of 6 *V. seheli* having ova diameter 0.01 to 0.1 mm, and one *L. macrolepis* having the ova diameter of 0.4 mm were administered with pituitary injection. But all fish died within 48 hrs. During the month of December, 4 *L. macrolepis* having the ova diameter of 0.43, 0.41, 0.53 and 0.1 mm were given with hormone injection at the dosage of 2 mg/kg of the body wt after 10 days interval. The injected fish are in good condition and it is proposed to give further doses in the 1st quarter of 1980. Work on collection of breeders and induced breeding showed that the transportation by cage is quite suitable for larger specimens and for smaller fishes such as *L. macrolepis,* the transportation by fibre-glass tank was suitable. On the whole, the transportation of live adult mullets by using those two methods are quite suitable without causing any injury to the fishes.

Regarding the culture experiments, seeds of *L. vaigiensis* of the size ranging from 25 to 75 mm were stocked in the pond of the area 225/m^2 at the stocking rate of 5/m^2 for monoculture experiment. The experiment during 9 months period showed an average monthly growth of 3.5 mm with the average body weight of 1.02 gm registered for that species. The experiments will be continued for 3 more months to see the growth in one year period. The studies at Theedai area on diurnal variation on the occurrence of mullet seed revealed that the seed of *L. viagiensis* can be obtained in good numbers in that area throughout the year with their peak abundance in January, February, May to July 1979. It was also informed that 3 to 6 days after the full and new moon periods are suitable time for seed collections. Early morning and late night good numbers of seeds obtained. The study was completed by the end of October, 1979. Further attempts are being made to see whether the seeds of *M. cephalus* are available in this area.

Narakkal:

At Narakkal induced breeding experiments were conducted with pituitary extracts of *Mugil cephalus, Liza macrolepis, L. parsia, Valamugil cunnesiue.* Human chorionic gonadotrophin along with pituitary extracts to give better results. The dosage injected varied from 0.5 ml to a maximum of 1 ml. The injections were administered intramuscularly at the dorsal side lifting a scale mildly. The fertilised eggs were reared in plastic troughs with good aeration. Bacterial and fungal infection of breeders were checked by dipping breeders in weak solutions (approximately 200 p.p.m. and 100 p.p.m.) of copper sulphate and potassium permanganate in sea-water. The use of chloromycetin at a concentration of about 2 p.p.m. in the culture tanks also was equally effective in preventing infections to some extent. Quick dip treatments of the breeders in a 3 p.p.m. solution of acrifleying also helped in checking infections during repeated handlings.

Induced breeding experiments were conducted on three species namely *M. cephalus. Liza macrolepis* and *Liza parsia.* The first successful spawning resulting in fertilized viable eggs was achieved on 27-9-79 in a *Liza parsia* specimen. Four specimens of *L. parsia* produced fully mature, viable eggs as a result of hypophysation of these even though in 30 of them the fertilized eggs ceased developing further after a length of time, the eggs from one specimen (Length 160 mm) hatched after 20 hours of incubation into viable larvae on 28-10-79, Approximately 4500 larvae were obtained in this brood. The larvae survived to a maximum period of 8 days.

In order to experiment whether sexual maturity in mullets (especially females) can be achieved by keeping them in sea-water containers, 4 *M. cephalus* specimens were kept in water of an initial salinity of 17.7 p.p.m. early in February, 1979. The salinity was then gradually raised to 23 p.p.m. The specimens were fed with a mixture of ground-nut cake powder and rice bran. Unfortunately was then gradually raised to 23 p.p.m. The specimens were fed with a mixture of ground-nut cake powder and rice bran. Unfortunately in all three series of experiments, the specimens died during the observations.

CRUSTACEAN FISHERIES DIVISION

The main research activities of the Crustacean Fisheries Division during the year 1979 were included under eight research projects on the resource aspects in the capture fisheries and four projects in the culture fisheries of crustaceans like prawns, spiny lobsters, crabs and stomatopods. Only one project on the evaluation of penaeid prawn fishery with special reference to fishing effort and size distribution at selected centres was initiated in the year.

On the capture fisheries side the important features of the resources during the year were: (1) the total production in prawns showed a slight decrease in comparison to that of the previous year; (2) the penaeid prawn fishery was relatively of lesser magnitude, mainly brought about by the decrease in catches in Kerala state; (3) the marked decline in the penaeid prawn catches of the mechanised boats operating at Neendakara, the most important landing centre of Kerala state and constituted mostly by the smaller species *Parapenaeopsis stylifera;* (4) the improvement in the penaeid prawn fishery at Cochin with *Metapenaeus dobsoni* as the dominant species; (5) the spiny lobster fishery showed a trend towards improvement at all the centres except Tuticorin and Kanyakumari District and (6) the stomatopod landings of the mechanised boats almost entirely consisted of a single species at all the observation centres.

In the field of culture fisheries the important research results achieved were: (1) in the typical brackish water ponds as those prevailing in the Cochin region, *Penaeus indicus* was found to grow at a fast rate of about 2 mm per day during the first 40 days after stocking, with slowing down of the growth rate dur-

ing the subsequent period of culture; *P. semisulcatus* and *P. monodon* cultured in coastal ponds and salt pan reservoir respectively also showed fast growth rate during the initial 30 days after stocking; (2) intensive farming of *P. indicus* at a stocking density rate of 50,000 seed/ha gave a harvest of 380 kg/ha during 110 days of field culture; (3) experiments to replace *Artemia nauplii* for feeding the mysis stages with artificial feeds such as powdered clam and prawn meat and blended prawn flesh gave encouraging results; (4) using the technique of unilateral eyestalk ablation, repeated rematuration of spent spawners of *P. indicus* resulted in successive spawnings; (5) an effective land based maturation facility has been set up at the Narakkal laboratory for inducing the prawns to mature in captivity; (6) eye ablation techniques were successfully tested in the crab *Scylla serrata* and (7) laboratory hatched phyllosoma larvae of the spiny lobster *Panulirus homarus* were reared upto the sixth stage in 60 days.

The Division actively participated in the project on the Assessment of Fry Resources of Penaeid prawns at selected centres in Kerala and Karnataka funded by the Marine Products Export Development Authority, with Dr. P.V. Rao as the Officer-in-Charge.

Assessment of penaeid prawn resources (CF/RE/1.1.1)

M.J. George, K.N. Rajan, P.E. Sampson Manickam, S. Lalitha Devi, D.B. James, G. Nandakumar, Mary K. Manissery, M.M. Thomas, N.S. Kurup, V. Thangaraj, Subramanian, M.M. Kunju, K.K. Sukumaran, K.Y. Telang S. Ramamurthy, M. Aravindakshan, G. Sudhakara Rao, P.V.K. Rao, M.V. somaraju, W. Venugopalam, A.C. Sekhar, C. Nalini, K. Chellappan and J.D. Eapen.

In the penaeid prawn fishery, while most of the centres along the west coast excepting Bombay,

TABLE--8

Penaeid prawn fishery at various centres in 1979

	Veraval‡	Bombay		Mangalore
		Sassoon Dock	Kasara Bunder	
I Mechanised fishery				
(a) Catch in tonnes	946.4	2430	6360	1297.4
(b) Catch/effort in Kg	7.4 (hour)	136.5 (boat day)	358.4 (boat day)	33.7 (boat day)
(c) Important species*	i, b, c, k	b, i, j	j, i, b	a, i, c, e
(d) Productive months**	10, 12 & 11	11, 8, 10, 12 & 9	12. 10, 8, 1 & 9	5, 4, 2, 3 & 1
II Indigenous fishery				
(a) Catch in tonnes	—	—	—	4.9
(b) Catch/effort in Kg	—	—	—	30.9 (Cast net)

* a—*M. dobsoni*; b—*M. affinis*; c—*M. monoceros*; d—*M. brevicornis*; e—*P. indicus*; f—*P. merguiensis*; g—*P. monodon*; h—*P. semisulcatus*; i—*P. stylifera*; j—*Solenocera crassicornis*; k—*M. kutchensis*

** Calendar months

‡ September–December data

Table 8 (contd.)

(c) Important species*	—	—	—	a, e
(d) Productive months**	—	—	—	8, 9 & 7
III Price structure				
(a) Jumbo	—	—	70–80	—
(b) Large	—	35–42.00	30–40	37.00–54.00
(c) Medium	—	12–16.00	8–25	21.50–30.00
(d) Small	—	6–12.00	2–6	4.50–15.00
(e) Tiny	—	2–3.50	1–1.50	—

		Calicut	*Neendakara*	*Cochin*	*Tuticorin*
I					
(a)		338.0	14,582	3369.8	404
(b)		39.2 (boat day)	4.2 (hour)	12.7 (hour)	1.8 (hour)
(c)		a, i, e, c	i, a, e, b, c	a, i, e, b	h, e, a
(d)		3, 2, 12, 1 & 4	7, 8, 6 & 5	5, 12, 3 & 6	5, 10, 12, 9, 6 & 7
II					
(a)		41.4	—	4.0	—
(b)		—	—	—	—
(c)		a, e, i	—	a, e	—
(d)		7 & 8	—	7	—

Table 8 (contd.)

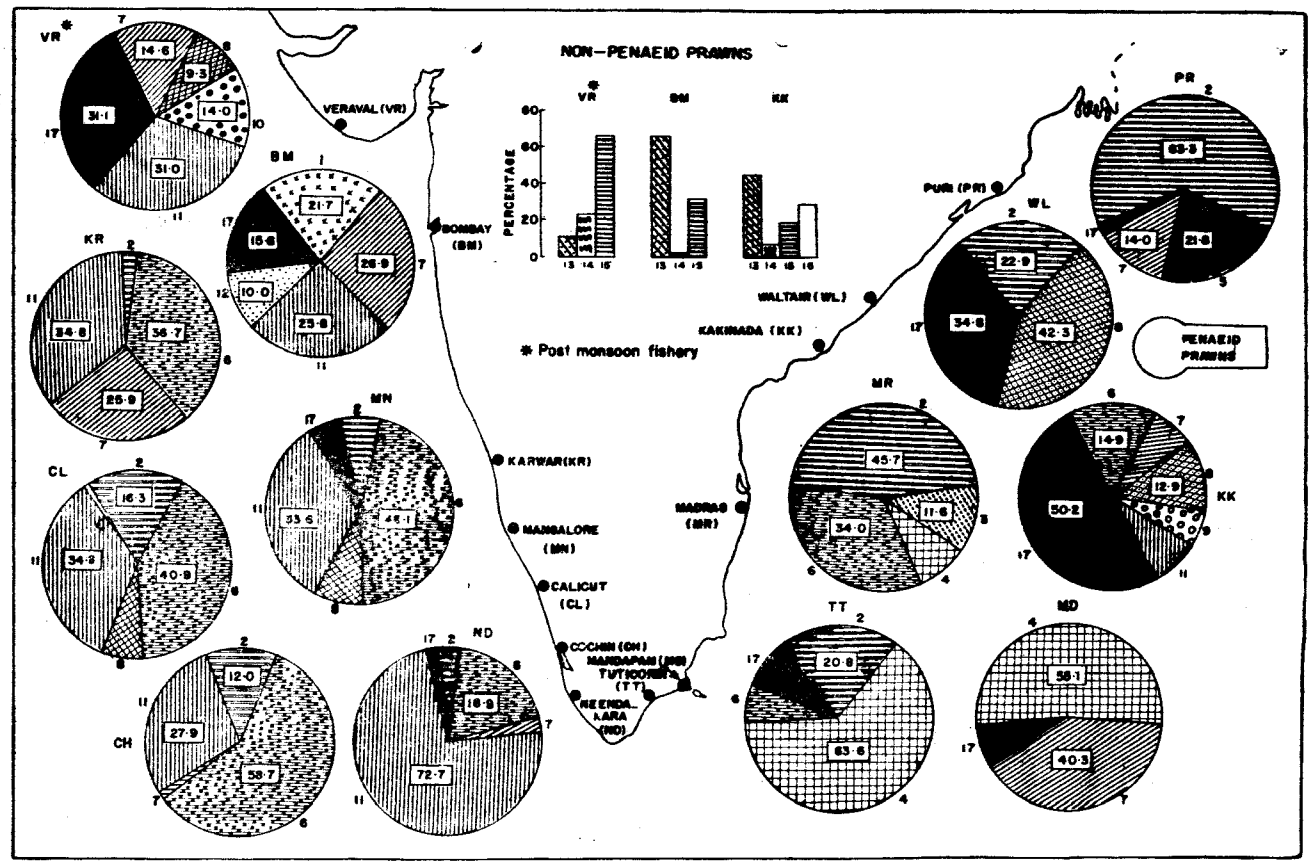
III	...	...				
(a)	...	...	—	—	—	—
(b)	...	...	—	—	—	56.00
(c)	...	...	—	—	—	32.00
(d)	...	...	—	—	—	15–20
(e)	...	...	—	—	—	—

		Mandapam	*Madras*	*Kakinada*	*Waltair*	*Puri*
I						
(a)	...	419.3	173.3	1650.8	708.6	52.1
(b)	...	14.7 (boat day)	3.2 (hour)	6.0 (hour)	2.9 (hour)	0.2 (hour)
(c)	...	h, b, f	e, a, g, h	a, c, i, b, e, d	c, e, g	e, f, b
(d)	...	5, 4, 6 & 8	5, 1, 9 & 2	5, 9, 4 & 1	11, 7, 12 & 1	10, 12&11
II	...					
(a)	...	—	—	163.3	—	—
(b)	...	—	—	0.7 (hour)	—	—
(c)	...	—	—	a, i, d, e	—	—
(d)	...	—	—	2, 9, 3 & 8	—	—

Tabie 8 (contd.)

		Mandapam	*Madras*	*Kakinada*	*Waltair*	*Puri*
III	...					
(a)	...	—	—	—	—	—
(b)	...	—	53–65	50–60	—	55–70
(c)	...	—	30–35	24–40	—	14–18
(d)	...	—	18–22	5–18	—	—
(e)	...	—	—	—	—	—

1 *Jumbo* —*P monodon & P. semisulcatus*
Large —*P. indicus, P. monodon, P. semisulcatus, P. merguiensis*
Medium —*M. affinis, M. monoceros*
Small —*P. stylifera, M. dobsoni*
Tiny —*Solenccera crassicornis, M. dobsoni etc.*



Percentage distribution of important species of prawns landed at different centres during 1979.
1. *S. crassicornis*, 2. *P. indicus*, 3. *P. monodon* 4. *P. semisulcatus*, 5. *P. merguiensis*, 6. *M. dobsoni*, 7. *M. affinis*, 8. *M. monoceros*, 9. *M. brevicornis*, 10. *M. kutchensis*, 11. *P. stylifera* 12. *P. hardwickii*, 13. *A. indicus*, 14. *H. ensirostris*, 15. *P. tenuipes*, 16. *P. styliferus* 17. others

showed decreased catches, all the centres along the east coast except Puri registered improved fishery in 1979. In Kerala while Neendakara showed considerably lesser catches in comparison to 1978 in Cochin and Calicut the fishery improved very much

Shrimp trawlers at Neendakara

Prawn catch being sorted

recording almost 50% increase. But the decline in the landings at Neendakara is very conspicuous and this has been noticed at this centre for the past several years. At Calicut although the

fishery showed improvement the size of prawns landed were smaller when compared to previous year, showing a decrease in mean lengths in all the species. At Mangalore the mean lengths of important species increased this year. Along with the improvement in the fishery at Cochin the representation of *Metapenaeus dobsoni* also increased, becoming the dominant species. But *Parapenaeopsis stylifera* continued to be dominant at Neendakara.

Assessment of non-penaeid prawn resources (CF/RE/1.1.2)

S. RAMAMURTHY, V.D. DESHMUKH, S. LALITHA DEVI, V.S. KAKATI, G. SUDHAKARA RAO, W. VENUGOPALAM AND S. LAKSHMI

The non-penaeid prawn fishery showed increased landings in comparison to previous year in all the observation centres namely Bombay (Versova and Sasson Dock), Veraval and Kakinada. While *Acetes indicus* dominated the catches at Bombay and Kakinada, *Palaemon tenuipes* was dominant at Veraval. In the case of *P. tenuipes* predominance of females was noticed in the population of both Bombay and Kakinada. The fishery of *Macrobrachium rosenbergii*, although showed revival in the Pampa river system and Cochin backwaters during 1978, has slightly declined in this year.

Assessment of prawn resources in the nursery grounds (CF/RE/1.1.3)

C. SUSEELAN, K.N. RAJAN, P.E. SAMPSON MANICKAM, S. LALITHA DEVI, K. DEVARAJAN, V.S. KAKATI, K.K. SUKUMARAN, K.Y. TELANG, P.V.K. RAO, M.V. SOMARAJU, W. VENUGOPALAM, A.C. SEKHAR, K.N. GOPALAKRISHNAN, S. LAKSHMI, K. CHELLAPPAN, J.D. EAPEN AND K. KOUMUDI MENON

The abundance of juvenile prawns in most of the major nursery areas studied was relatively higher as compared to the previous year except at Calicut and Waltair. *P. indicus* was the principal species at Mangalore, Waltair and Puri, *M. dobsoni* at Calicut and Cochin and *M. monoceros* at Kakinada. The major size groups of *P. indicus* in the fishery belonged to 66–120 mm at

most of the centres. At Kakinada and Waltair smaller sizes of the species were dominant. At Cochin the mean size of the dominant species *M. dobsoni* at the peak season was slightly lesser than in previous year. Higher recruitment of *P. indicus* is noticed at Mangalore and Cochin in comparison to previous year. Post larvae of *P. canaliculatus* were recorded from Cochin backwaters.

Evaluation of penaeid prawn fishery with reference to size and effort (CF/RE/1.1.4)

M.J. GEORGE, M.M. THOMAS, C. SUSEELAN, N.S. KURUP, V. THANGARAJ SUBRAMANIAN AND C. NALINI

Data collected in earlier years at a few selected observation centres have been examined with special reference to size of the prawns and the effort expended to catch them. The relevant data on size and effort have been collected from some centres. Further work is in progress.

Assessment of lobster and crab resources (CF/RE/1.3)

P.V. KAGWADE, S. LALITHA DEVI, E.V. RADHAKRISHNAN, K.M.S. AMEER HAMSA, M. KATHIRVEL, G. SUDHAKARA RAO, W. VENUGOPALAM, M. MANICKARAJA, K.K. BALASUBRAMANIAN

The lobster fishery in 1979 showed a trend towards improvement at all the centres except Tuticorin and Kanyakumari district when compared to last year. The increase in the catch was more than two fold at Bombay and marginal at other centres. The catches at Tuticorin and Kanyakumari district were almost half of that of 1978. While *Panulirus polyphagus* was the dominant species in the northern part of the west coast, *P. homarus* was dominant in south-west coast, Tuticorin and Madras. The contribution of *Thenus orientalis* to a large percentage of the fishery of both Gujarat and Maharashtra coast is a noteworthy feature. The sizes of the important species did not show appreciable change from those observed in previous years. The crab fishery at Mandapam and Kakinada showed considerable improvement.

TABLE--9

Estuarine prawn fishery at different centres during 1979

	MANGALORE	CALICUT	COCHIN	KAKINADA	WALTAIR	PURI
Estimated catch in tonnes	2.7@	67.3	2068	1489 (638.4 at B.V.Palem)	7.8	26.9
Catch/unit in kg.	2.6	11.1	2.10**	16.5 (at B.V. Palem)	3.2	0.63*
Fishing gears	Cast nets	Stake nets	Stake nets Cast nets Gill nets	Drag nets Stake nets	Drag nets	Drag nets
Important species	*P. indicus*	*M. dobsoni* *M. monoceros* *P. indicus*	*M. dobsoni* *P. indicus* *M. monoceros*	*M. monoceros* *P.indicus* *P. monodon*, *M. dobsoni*	*P. indicus* *M. monoceros* *M. dobsoni*	*P. indicus* *M. monoceros* *P. monodon*

@ Landing during November–December period only.
* Catch/hour **Catch/unit for stake nets

TABLE--10

Lobster landings at different observation centres in 1979 and 1978

	1979		1978
Centre	*Catch (tonnes)*	*Catch/unit (Kg)*	*Catch (tonnes)*
Veraval*	28.8	1.6	160.8
Bombay	374.0	8.80	163.8
Calicut	2.2	1.27	2.1
Kanyakumari district	20.9	—	41.9
Tuticorin	8.7	2.19	15.9
Mandapam	3.1	—	2.5
Madras	7.0	—	6.2

**October–December data*

Prawn fishery atlas (CF/RE/1.4)

E.G. SILAS, S.K. DHARMARAJA, K. RENGARAJAN AND I. DAVID RAJ

Relevant data on prawn resources and fisheries from different areas along the coastline of India were collected and analysed with reference to charting and mapping. Some more maps and charts were drawn and added to the model copy prepared earlier.

Genetic resources of the commercially important prawns (CF/RE/1.6)

M.M. THOMAS, N.S. KURUP, S. LAKSHMI, C. NALINI AND K. CHELLAPPAN

Samples of *P. indicus* and *M. dobsoni* collected from Mangalore and Cochin on the west coast and Tuticorin and Puri on the east coast were analysed for morphometric measurements and data of fifteen parameters were recorded. In order to find out whether there are any significant differences between specimens from different localities, the data is being analysed statistically.

In addition, specimens of the same species from different environments such as inshore waters, backwaters and culture ponds were also collected and data on the different parameters recorded. Analysis of the data is in progress.

Besides these, electrophoretic studies on protein of selected species of prawns have been initiated.

Assessment of stomatopod resources (CF/RE/1.7)

M.M. KUNJU, K.K. SUKUMARAN, K.Y. TELANG, A.C. SEKHAR, M. AYYAPPAN PILLAI, K. KOUMUDI MENON, O. THIPPESWAMY.

The estimated total landings by the mechanised boats at Karwar, Mangalore, Calicut and Cochin during the year have been 2103.5 tonnes composed entirely of a single species, namely *Oratosquilla nepa*. The sizes ranged from 76 mm to 135 mm at Karwar. At Mangalore the most productive months were March and December. Females dominated in the catches at all centres.

Intensive culture of marine prawns (CF/Cul/1.1.1)

P.V. RAO, C.P. RAMAMIRTHAM, M. KATHIRVEL, SYED AHMED ALI, M. AYYAPPAN PILLAI, C. THANKAPPAN PILLAI, K.K. SUKUMARAN, O. THIPPESWAMY, M.M. KUNJU, K.K. BALASUBRAMANIAN, G. NANDAKUMAR, S. SHANMUGAM, K.A. NARASIMHAN, V. SRIRAMACHANDRA MURTHY AND S. LALITHA DEVI.

Experiments on the culture of *Penaeus indicus, P. semisulcatus* and *P. monodon* in the grow-out ponds having different ecological characteristics were carried out at Cochin, Mandapam and Kakinada respectively. In the typical brackish water ponds as those prevailing in the Cochin region, *P. indicus* was found to grow at a fast rate of about 2 mm per day during the first 40 days after stocking. *P. semisulcatus* and *P. monodon* cultured in the coastal pond and salt pan reservoir respectively also showed appreciable growth rate in the initial 30 days after stocking. The growth rate in all the species in the subsequent period of culture slowed down, although they attained the marketable size within 100–120 days. In the intensive farming of *P. indicus* at a stocking density rate of 50,000 seed/ha, harvestable production was of the order of 366 to 380 kg/ha during, 78 to 110 days of field cul ture. Large-scale mortality due to the development of 'soft' condition in the prawns measuring over 70 mm size was encountered in several experiments.

Mass production of prawn seeds (CF/CUL/1.1.2)

M.S. MUTHU, N.N. PILLAI, C.P. GOPINATHAN,
S.K. PANDIAN, M. RAJAMANI, A. LAXMINARAYANAN,
C.M. JAMES, SYED AHMED ALI, K. DEVARAJAN,
K.K. SURENDRAN AND C.S. SASIDHARAN

Using the technique of unilateral eyestalk ablation *Penaeus indicus, P. monodon, Metapenaeus dobsoni* and *Parapenaeopsis stylifera* were induced to mature and spawn successfully. Out of 25 females of *P. indicus* that became fully mature, stages upto postlarvae were reared in 14 spawnings. The number of eggs spawned varied from 14,540 to 1,66,950. 14 prawns became fully mature 9 to 27 days after eyestalk ablation. In the case of *P. monodon,* 9 females spawned after eyestalk ablation, the number of eggs varying from 44,480 to 7,47,500. In some specimens rematuration also occurred after eyestalk ablation. An effective land-based maturation facility has been set up at Narakkal prawn culture laboratory. Experiments to replace *Artemia* nauplii for feeding the mysis larvae with artificial feeds such as powdered clam and prawn meat and blended prawn meat gave some encouraging results. Larval rearing experiments to increase the survival rate in mass production of seeds are being continued.

Investigations on induced maturation and spawning of commercially important penaeid prawns under controlled laboratory conditions using the eyestalk ablation technique and the maintenance of the broodstock in land-based maturation pools were conducted. Various methods to improve the survival rate of the larvae in mass rearing of penaeid prawns were tried.

Culture of commercially important crabs (CF/CUL/1.1.3)

R. MARICHAMY, N.N. PILLAI, M. KATHIRVEL,
A. MANICKARAJA AND S. RAJAPACKIAM.

Cage culture of the green crab *Scylla serrata* was continued at Tuticorin. Seeds stocked in October 1978 at sizes 50–75 mm carapace width attained 122–143 mm by April 1979. The

total gain in weight was 22.9 kg with a survival rate of 86.7%. 1381 crab seeds were collected from the wild and stocked in two ponds along with milk fish and mullets. Crabs under size groups of 90 mm carapace width showed growth rate of 10 mm CW and 30–40 g per month. In larger crabs fattening was more prominent than in increase in size. Eye ablated young ones show frequent moulting and fast growth rate. Maturing crabs were stimulated for gonadial maturation and fertilization of eggs by eye ablation.

Culture of spiny lobster (Panulirus sp.) (CF/CUL/1.5)

T. THOLASILINGAM, K. RENGARAJAN AND E.V. RADHAKRISHNAN

Good progress was made on breeding of spiny lobster. *Panulirus homarus* in the laboratory and rearing of phyllosoma larvae. The larvae were successfully reared through 6 stages in a series of 8 moults in 60 days. *Artemia salina* nauplii have been used as food for the larvae. Various other feed were also tried. Different types of collectors like Mangalore tile, country tile, nylon fibres, coir fibres, automobile tyres and iron frames were tried for collecting pueruli. Forty one pueruli of *P. homarus, P. polyphagus* and *P. ornatus* were collected and successfully reared in the laboratory tanks. December to April appears to be the season for their occurrence. 110 juveniles of *P. homarus* were collected from the inshore rocky coast and maintained in the laboratory.

MOLLUSCAN FISHERIES DIVISION

The main thrust of this Division's work during 1979 was to promote researches on intensive and extensive culture of the edible oyster (*Crassostrea madrasensis*), the green mussel (*Perna viridis*) and the brown mussel (*Perna indica*). The progress had been so satisfactory and promising that mussel and oyster culture programmes were taken up for the transfer of technology programme under the Lab-to-Land scheme during 1979. Significant progress was made towards development of techniques for hatchery production of seed. The researches on pearl culture made further progress. Training programmes for fishermen and technical personnel of research departments were implemented.

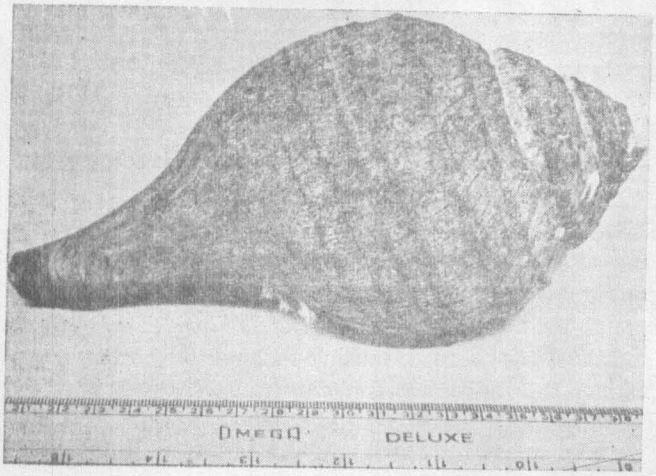
The salient features of the Division's projects are detailed below:

Resources survey of commercially important molluscs (MOL/RE/1.1)

K. NAGAPPAN NAYAR, S. MAHADEVAN, K. RAMADOSS, T. APPA RAO, K.A. NARASIMHAN, Y. APPANNA SASTRI, R. SARVESAN, D. SIVALINGAM, P. NATARAJAN, K.K. APPUKUTTAN, M.M. MEIYAPPAN, A.A. JAYAPRAKASH, P.S. KURIAKOSE, K. SATYANARAYANA RAO, SYDA RAO AND K.S. SUNDARAM.

A preliminary survey from Bombay Centre revealed that the rocky inter-tidal area of Uttan, Bhat-Bunder, Hadh, Worli and Bandra-Chimbaryi provided suitable substratum for oyster populations ranging in number from 590-1690/sq.m. The clams *Paphia textile, Meretrix* sp. and *Katelysia* spp. were being fished. Thana creek was exploited for the clam *Paphia* sp.

The molluscan resources of Nethravathi, Gurpur, Pavanji, Sambhavi, Swarna, Sitnadi, Coondapur, Bindur and Bhatkal estuaries were surveyed by the Mangalore Centre and the den-



Xancus pyrum var, acuta, the chank commonly fished along south-west coast

Chanks caught in long-lines

sity of potential stock have been estimated. The total estimated landings of clams *Meretrix casta* and *M. malabarica* in 1979 in

Mulki estuary were 246.9 tonnes, which were much less than that (425.5 tonnes) of 1978. The annual mussel landings at Calicut, Moodadi, Thikkodi and Mahe have been estimated at 52.9, 463.5, 50.4 and 379.8 tonnes.

From the Vizhinjam and Cochin centres, Poovar, Panathura and Veli were surveyed and *Villorita* spp. were observed. Clam and oyster resources at Anchango (Muthalapozhi) Kappil, Edava and Paravoor were studied. The clam fishery (*Villorita*) at Akathumuri was studied.

Regular landings of chanks from Quilon, Vizhinjam, Colachal, Kadiyapatanam and Enayam took place for the first time. At Quilon the total estimated catch from 1978 December to 1979 December was 17,050 nos. At Quilon the landings were mainly from trawl catches and few were collected by diving around Varkala area. At Vizhinjam 90% of the catch was by hook and line. At Colachal, Enayam and Kadiyapatanam the landings were mainly from diving.

Detailed resurvey of the islands present in the Gulf of Mannar totalling 20 was undertaken from Tuticorin and completed. A clear picture of distribution of various molluscs in and around each island emerged by the studies. A few sea trips were made during the year for SCUBA diving to the near shore paar areas. It was possible to collect 10 pearl oysters per sq.m. of size varying from 30–40 mm. Large proportion of dead pearl oyster shells (35–45) were noticed.

The oyster bed at Kakinada–Upputeru was found to extend upto a distance of 2.3 km up from the creek mouth and the density of oysters was high close to the mouth of the creek. The oyster bed had a spread of 2.25 ha. and the population was estimated to be about 11.7 million in number and 89.895 tonnes in weight. At this centre the green mussel *Perna viridis* was observed to occur in patches along with the oysters, closer to the low water mark. The total area inhabited by the mussel was 0.75 ha. The density per sq.m. varied from 0–12 nos. with an average of 1.02/m. The molluscan resources of Ramanapalam creek, Chippaleru creek and Pentakota creek were also surveyed.

From Waltair, Mutyalammapalem, Gangavaram, Kuppili, Pukkalapete, Kalingapatnam and Pundi (Nuvuls Revu) back-

waters were surveyed. A modest fishery for clams existed only at Pundi backwaters.

Survey of Cephalopod resources in the economic zone (MOL/RE/1.2)

E.G. SILAS, H. MOHAMED KASIM, KUBER VIDYASAGAR, M.M. MEIYAPPAN, K. PRABHAKARAN NAIR, D. SIVALINGAM, R. SARVESAN, Y. APPANNA SASTRY AND B. NARAYANA RAO.

An estimated 14,805 tonnes of cephalopods were caught during the year 1979 mostly by shrimp trawlers. The catch had decreased by about 7% from that of 1978. This is mainly due to the decrease in landings in Kerala and Maharashtra. Gujarat accounted for 37.3% of the catch, followed by Maharashtra 22.6% and Kerala 20.7%.

At Veraval, an estimated 580 tonnes of squids and cuttle fishes were caught by trawlers during the last four months, representing about 4.8% of the total trawler landings. The average catch per unit of effort was 4.5 kg/hr. *Sepia aculeata* (51.8%) and *Loligo duvauceli* (4.1%) were the dominant species. The mean length of the above species ranged 77–98 mm and 68.4–95 respectively.

At Bombay the cephalopod landings amounted to 989 t, 882 t and 10 t at Kasara Bunder, Sassoon Docks and Versova respectively. The catch showed remarkable increase over that of 1978 catches—at Kasara Bunder it was 164%—although there was a decline in the overall cephalopod landings of Maharashtra. *Loligo duvauceli* (size range 30–264 mm) *Sepia aculeata* (34–289 mm) were the dominant species. *Speia pharaonis*(150–329 mm) was caught in good quantities in December.

At Cochin Shrimp trawlers hauled about 395 t of cephalopods, an increase of about 117% over that of 1978. The catch rate (1.49 kg/hr) was also high during this year. About 70% of the annual catch came in the month of August. Unlike last year, cuttle fishes dominated in the catches this year (71.9%). The catches and the size range of the commercial species were respectively—*Sepia elliptica* 158 t and 58–118 mm; *S. pharaonis* 42 t and 70–211 mm; *S. aculeata* 42 t—65–156 mm; *Sepiella inermis* 41t and 34–108 mm; and *Loligo duvauceli* 111 t and 57–225 mm.

At Vizhinjam the landings by indigenous gears amounted to 244 t forming 4.2% of the total. Peak catch was in September (59%). Boat seines and hooks and lines accounted for 57% and 43% of the catch respectively. The catch rate of the above gears were 2.89 and 2.06 kg/unit effort respectively. 60% of the catches was of squids represented by *L. duvauceli* and *Doryteuthis singhalensis*, their size ranges being 25–285 mm and 26–235 mm. *S. pharaonis* was the dominant cuttle fish, its size ranging from 85 to 305 mm. The product yield of *S. pharaonis* was about 40 to 55% in total weight.

At Mandapam (Palk Bay) an estimated 29 t were landed of which about 22 t were *S. aculeata* caught during night trawling, and the rest *L. duvauceli* caught during the day trawling. At Rameswaram the night trawling operations yielded about 68 t of *S. aculeata*. The size ranges of *S. aculeata* and L. *duvauceli* were respectively 53 to 132 mm and 40 to 129 mm.

At Madras 51 tonnes of cephalopods were caught mostly by shrimp trawlers. The catch had declined by about 13% when compared to that of last year. The catch rate was 4.5 kg/boat and 0.9 kg/hr.

Peak catch was in September. Squids accounted for 52% of the cephalopod catch. *L. duvauceli* was the dominant species. Cuttle fishes were represented by *S. pharaonis, S. aculeata, S. winckworthi* and *Sepiella inermis.*

At Kakinada 124 t were landed by shrimp trawlers. Cephalopods formed 1.3% of the total landings and the catch rate was 0.3 kg/hr. *Sepiella inermis, S. aculeata, S. pharaonis* formed 45%, 25%, and 10% respectively. Squids were represented by *L. duvauceli* (20%). The size range of the above species were 27 to 87 mm, 22 to 143 mm, 32 to 182 mm and 27 to 152 mm respectively. *S. pharaonis* occurred in good quantities during night trawling.

At Waltair 331 t of cephalopods were landed by shrimp trawlers. It represented an increase of about 100% over that of 1978 catches. *L. duvauceli* (41%) and *S. aculeata* (31%) formed the bulk of the catch. The peak catch was in September. The size range of *L. duvauceli, S. aculeata. S. pharaonis, S. winck-*

worthi and *S. inermis* were respectively 30–125 mm, 40–180 mm, 45–195 mm, 35–95 mm and 30–80 mm.

The cephalopod landings data for 1968–1977 were analysed for State-wise, Zone-wise and gear-wise production for the preparation of a Bulletin on the Cephalopod Resources of India.

Genetic Resources of commercially important molluscs (MOL/RE / 1.5)

K. ALAGARSWAMI AND P.V. SRINIVASAN

The project on genetic resources of molluscs was started during 1979 with the ultimate objective of identification and cateloguing of the genetic resources of the cultivable species of molluscs and breeding and selection of types showing advantageous characters for culture. Preliminary work for starting karyological and electrophoretic studies was completed. Morphometric studies on the clam *Meretrix casta* were started. It is proposed to extend the work to include material on an all-India basis and to include other groups of molluscs, particularly the edible oysters and pearl oysters. Pearl oyster material for the study has been collected. Karyological and electrophoretic studies will also be made.

Culture of edible oysters (MOL/CUL/1.1)

K. NAGAPPAN NAYAR, S. MAHADEVAN, K. RAMADOSS AND M.E. RAJAPANDIAN.

Studies on oyster culture showed encouraging results, especially on the collection of spat and growing oysters to harvestable size by following the rack and tray system. A predatory gastropod *Cymatium sp.* caused considerable damage to the stock especially when the oysters were below 4 months old. This was controlled by removing them during July to September when they occurred. Purification tanks were constructed for treating the oysters.

Intensive studies on the seasonal gonadial changes and on the various hydrological features of the farm area were made. Indeterminate stage of gonad was dominant during May, June and July. Although the female oysters showed maturing and ripe stages of gonads almost throughout the year, biannual maxima

was quite apparent during February to April and August and September. The spent stage was extremely at low level during July but was found to increase during October and November. The progression of sexual development among males appeared to be rhythmic and relatively high percentages were observed during the months of April, June, August, September and October. while observing the diurnal variations of the water temperature it was found that during certain months the mean values of the diurnal variations remained high. These months correspond to the periods of relatively higher sexual activity of the oysters.

During March and April, 1979, 50,000 lime coated tiles were laid at different locations. The best area registered a settlement of 23.8 spat per tile. A total of 5.6 lakhs of oyster spat were collected during this season. During September to October, 1979, 20,000 tiles were laid. The settlement of spat was very moderate. About 2.8 spat per tile were observed.

Culture of mussels (MOL/CUL/1.2)

S. MAHADEVAN, P.S. KURIAKOSE, S. REUBEN, SAMPSON MANICKAM, K. RANGARAJAN, N. RAMACHANDRAN AND K.K. APPUKUTTAN.

At Calicut a large scale demonstration project on mussel culture had been taken up and Lab-to-Land programme was implemented. The details of the progress made are reflected in the report under CMFRI/DP/2.

At Vizhinjam mussel culture was continued for the whole year in the bay and from January to May in the open sea. From March onwards the open sea rafts were subjected to heavy wave action. 114 ropes 5.5 m average length each were kept in the open sea and 144 ropes were released in the bay rafts. On 11th and 12th of May there was cyclonic weather condition and the open sea rafts were subjected to heavy wave action and there was loss of rafts. Mussel seed settlement started by August, but due to rough weather seed collection could not be done. Samples of spat from natural bed were collected. Settlement of spat in the spat settlers was poor compared to that of previous years. Seeding work commenced by 5th October. Only 3 m long ropes were released this year, since inside bay and open sea beyond 3 m the

growth rate was poor and falling out of mussels due to heavy wave action was found. Average seed used per meter was 1.4 kg and the mode of mussel seed ranged from 25–35 mm. Open sea farm mussels show faster growth and attain marketable size within 5 months ie: by the end of May. Here the rate of growth per month was 5 mm, whereas inside the bay it was only 2.94 mm. The condition index and flesh weight percentage showed an increase from January to May and a decline in June and July, the peak monsoon period and then an increase from August onwards. Inside the bay the average increase in total weight was 9.29 gms for one year with 0.77 gms. increase per month. The flesh weight increase was 3.77 gms with 0.32 gms per month whereas in the open sea the total weight increment for 5 months period was 9.72 gms with 1.92 gms per month and 4.5 gms of flesh weight increment in 5 months.

Green mussel culture by raft method was carried out in Kovalam near Madras. By the middle of January small quantities of seed were available on the rocks at Kovalam and the concrete pillars at Ennore pier. 36 ropes were seeded during this period using $\frac{1}{2}$kg seed per meter rope and the ropes suspended from the raft. The attachment was poor in all these ropes as the netting used over the rope for seeding the mussels was found torn within 2 or 3 days. Since mussel seed was not available after February, adult mussels were collected from Ennore and suspended from the raft in nylon bags for spawning. Mangalore tiles were used to collect the mussels spats. Spawning occurred during early April. Minute spats measuring about 2 mm in size were noticed on the ropes and tiles in late April. By the beginning of May fairly good settlement was noticed on all the tiles which were suspended near the bottom. Heavy damage was caused to the parent stock of mussels and the spats on the raft by the cyclone in May. The culture work was again started in late May when normal conditions were restored in the sea. Parent stock of mussels and spat collectors were again suspended from the raft. Heavy spawning took place in June and spat fall was so heavy that about 4 kg of mussel seeds ranging in length from 10–15 mm could be collected from each Mangalore tile.

During June intense spat fall also occurred on the rocks at Kovalam and by July seeds ranging in length from 15–20 mm were

available for seeding. 80 ropes were seeded during June/July using 3 kg of seed per rope. Attachment of seeds to the ropes was good and by early October good growth in mussels was noticed. In 3 months time $4\frac{1}{2}$ kg seed has attained a weight of 39 kg. The mussels were harvested by the middle of October 1979. The average production per rope worked out to about 10 kg.

Experimental work was taken up at Waltair. Adult green mussel *Perna viridis,* procured from Kakinada were kept suspended from a raft. Due to cyclone in May the raft was lost and no progress could be achieved.

Culture of clams and windowpane oysters (MOL/CUL/1.3)

K.A. NARASIMHAN, S. REUBEN, T. APPA RAO, P.E. SAMPSON MANICKAM, P.V. SRINIVASAN, G. RADHAKRISHNAN, K. SATYANARAYANA RAO AND G. SYDA RAO.

Investigations in this project are being carried out at Mangalore, Cochin, Kakinada and Waltair. *Meretrix meretrix* and *M. casta* var ovum at Mangalore *Anadare granosa* and *Placenta placenta* at Kakinada and *M. casta* at Cochin and Waltair are being studied for their suitability for culture with reference to various methods. At Cochin a preliminary survey of clam beds and the species available was made to find out locality and species suitable for culture. Two experimental transplantations of *M. casta* were carried out at Narakkal but due to the prevailing low saline conditions they did not survive.

The blood clam, *A. granosa* was cultured in three pens each measuring 100 m^2 in the subtidal region at Kakinada bay. The stocking rate in each pen was as follows: pen B 14000 clams of mean size 23.3 mm; pen C 3000 clams of mean size 25.1 mm and pen D 7000 clams of mean size 23.4 mm. In spite of the varying stocking density (14000, 7000, 3000) the growth of the clams was similar. The average estimated growth rate was 2.6 to 2.8 mm per month. It was also observed that during November–December due to rains and lowering of salinity, the growth rate was poor. After 5 months the clams were harvested. The production was as follows: pen B yielded 385.3 kg/100 m^2 with a survival rate 88.6%, pen C yielded 89.35 kg/100 m^2 with survival

rate 90.3% and pen D yielded 183.2 kg/100 m^2 with a survival rate 81.0%.

A study on the windowpane oyster *Placenta placenta* was taken up at Kakinada. The size varied from 29–162 mm with a mode of 109–127 mm. The oysters spawn twice in a year, during February–March and again in October–November. Extensive spat settlement was observed during February and May in the year under report.

At Waltair the biology of *M. casta* in the natural beds was studied, off bottom and on bottom cage culture of *M. casta* was also tried in which growth rates were of 0.7 mm/month and 1.0 mm/month respectively.

Pearl Culture (MOL/CUL/1 4)

K. ALAGARSWAMI, K.K. APPUKUTTAN, A.C.C. VICTOR, A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN.

Subsequent to the conclusion of the *ad-hoc* scheme on Pearl Culture in 1978, researches on pearl culture were taken up under a regular Research Project at Tuticorin and Vizhinjam. Emphasis was laid during 1979 on selected items of the technical programmes such as strengthening of the pearl culture farm, biological studies, productivity studies and control of fouling and borin gorganisms.

At Tuticorin pearl oyster collections were made from the natural beds during January–May and November–December. Thirty-six sea trips were made to Devi Paar, Vaipar Periya Paar and Tholayiram paar. The total collections made by SCUBA-diving amounted to about 35,000 oysters. As in previous years, Devi paar proved to be consistently good for oyster collection. The flat oyster population was considerably reduced. The oysters collected were reared in the farm at Veppalodai and also at the Harbour. It was found keeping the oyster cages on the slopes of breakwater in the harbour gave better results in terms of growth, reduced silt and fouling load than those suspended in the water column. Mortality of oysters in the farm was low compared to the previous years due to improved farm management procedures adopted.

A heavy mortality of pearl oysters in the northern sector of the natural beds of the Gulf of Mannar was noticed subsequent to the heavy rains in November and an estimated 25% of the population had died in Devi paar and Vaipar Periya Paar. It was presumed that the mortality was due to the sudden lowering of the salinity by the heavy discharge of fresh water by the rivers of the area.

Growth of oyster was studied in the farms at Veppalodai and Harbour. Growth rate was higher in the latter area than at Veppalodai. The stomach contents of the oysters consisted of the common diatoms of the area, bivalve eggs and shells larvae, and appendages of crustacean larval stages were commonly found among the stomach inclusions. Experimental work showed that eggs and larvae are ingested passively and pass out through the pseudofaeces or faecal matter, often without any damage as they are still viable. Maturity stages, index of condition and total-shell-meat weight ratios were other aspects of biology studied. Spat collection did not prove successful in the farm area.

The rate of infestation of pearl oysters by boring polychaetes and sponge was observed. Several series of experiments were conducted on the control of the boring organisms which included brushing with formalin, immersion in 0.1% formalin, fresh water, brine solution and N/10 ammonium hydroxide in sea water. Of these, immersion of oysters in fresh water was found to be most effective in controlling the polychaetes and brushing with 1% formalin in controlling the boring sponge. These results were extended to the oysters in the farm and data collected on the large-scale field application of the techniques.

Data on environmental parameters at Veppalodai farm were collected. Studies on primary production and respiration were carried out.

Nucleus implantation work was continued.

At Vizhinjam, spat fall was monitored both in the harbour and in the open sea. Spawning of oysters was observed by end of March and in May-June. A total of 2000 spat (15-34 mm) was collected. The spat fall was poor in the Bay because of heavy settlement of *Modiolus* and turbid nature of the water while

it was better in the open sea. Growth of oyster, food, sex ratio, maturity, condition index and length–thickness relationship were studied. Coastal area upto Muttom was surveyed and a few pearl oysters were found.

Development of hatchery system for edible oyster seed production (MOL/CUL/1.5)

K. NAGAPPAN NAYAR, D.C.V. EASTERSON, K. RAMADOSS, AND M.E. RAJAPANDIAN.

Experiments were conducted to induce the oyster, *Crassostrea madrasensis* to spawn. Temperature, salinity, pH and hydrogen peroxide were separately tried to stimulate spawning, in which only a limited success was obtained. *Isochrysis galbaha* a chrysomonad used for larval rearing was cultured successfully in modified Walne's and in Shiraishi's culture media. A small scale hatchery has also been designed on scientific lines and the construction of the building is nearing completion. The sea water purification system comprising of a deep sump, filter beds, pumps and a reservoir has been designed and the work completed during the year under report. The purification system was found to be functioning efficiently. Since aseptic sea water was required for larval rearing the necessary system has also been planned and the required apparatuses were also procured. The assembling of the system was also taken up.

Development of hatchery system for mussel seed production (MOL/CUL/1.6)

K. RENGARAJAN, N. RAMACHANDRAN, K.K. APPUKUTTAN

The studies were conducted on green mussel and brown mussel at Madras and Vizhinjam respectively. Inducement of spawning was attempted using external stimuli, namely pricking of adductor mussel, pegging and thermal shock. However, during the breeding season it was found that they released the spawn without external stimuli. The larvae was reared upto straight-hinge stage.

Development of hatchery system for production of pearl oyster seed (MOL/CUL/1.7)

K. ALAGARSWAMI, A.C.C. VICTOR, A. CHELLAM, D.C.V. EASTERSON, S. DHARMARAJ AND T.S. VELAYUDHAN.

Concerted efforts were made for developing techniques for induced spawning of pearl oyster and for rearing the larvae. Several experiments were conducted with Tris–buffer, sodium hydroxide, hydrogen peroxide, brine–solution injection of N/10 ammonium hydroxide solution, and thermal stimulation. Tris–buffered sea water with a pH of 9.0 was found to induce 79.6% of oysters to spawn. NaOH solution at 9.5 pH stimulated 68.4% of the oysters.

Development of eggs upto straight–hinge larval stage was followed. The larvae did not develop beyond this stage although they were fed with *Tetraselmis* and *Synechocystis*. The experiments were continued to achieve further development. Attempts were made to isolate nannoplankters from the general plankton and culture them.

Culture of cephalopods (MOL/CUL/1.8)

D. SIVALINGAM AND S. KRISHNA PILLAI

Egg clusters of squids and egg capsules of cuttle–fish, *Sepia aculeata* were collected from the shore seines and kept in the aquarium tank for hatching and rearing of young ones. Young ones hatched out mostly during night between 2130 to 2200 hrs, when the water temperature was around 31°C. They were fed with freshly collected plankton. They could not be reared successfully and all of them died after a few days time. This would have happened mainly due to lack of proper food for the young ones. Attempts are being made to find out a suitable food and continue the experiments.

Demonstration project in pearl culture (CMFRI/DP/1)

K. ALAGARSWAMI, A.C.C. VICTOR, A. CHELLAM,
S. DHARMARAJ AND T.S. VELAYUDHAN.

Under this project, nucleus implantation work could be carried out only during the first quarter. Considering the size of oysters available in the farm, nucleus of 3 mm and 4 mm diameter only could be used in single as double implantations. In view of the priority given to hatchery programme and training course this project recorded only moderate progress.

Demonstration project on edible oyster culture (CMFRI/DP/2)

For rearing oysters in the Tuticorin bay area, 85 racks were erected. For the purpose of spat collection during Mach–April season, three areas namely (a) natural bed area (b) bridge area and (c) bay area were chosen. In order to collect oyster spat during April–May 1979 season, 60,000 tiles were given lime coating. The settlement of spat during this season was quite successful. The average number of spat per tile kept in the bay area was found to be 23.8. The average spat tile in the bridge and bed area was 10.8 and 8.7 respectively. The shallow water open sea spat collection indicated the great potentialities of attempting large scale spat collection. A total of 5.6 lakhs of oyster spat were collected. During September–October spat collection season 20,000 lime coated tiles were used. Only 57,000 spat were collected during the season. The oysters were grown by rack–tray method. During thinning, 250 nos. of predatory gastropod of *Cymatium cingulatum*, size ranging from 10 to 76.6 mm, were removed.

Demonstration project on mussel culture (CMFRI/DP/3)

P.S. KURIAKOSE

The project was carried out at Calicut. A total of 2400 ropes, each 7 m length were suspended from 7 raft units. Seed of suitable size (10–25 mm) were available in plenty from September to December. The juvenile mussels were hand pciked from the inter tidal and submerged rocks along the coasts of Elathur, Thikkodi and Mahe. The seed then were filled in gunny bags in moist condition and transported from different collection centres to the field laboratory at Calicut in jeep. For seeding 4 kg of seed were securely wrapped around coir and nylon ropes using knitted cotton cloth. The seeded ropes were suspended from the bamboo poles of the rafts about 0.5 m. apart. The seed mussels got attached over the ropes secreting new byssus threads within one or two days. The cloth cover disintegrated in sea water within 10 days.

Seed mussels having an average length of 20.6 mm weighing 0.68 gm. transplanted in the second week of November 1968, grew to an average size of 88.2 mm weighing 29.5 gm in the

second week of April 1979. Average meat weight of the seeds at the time of transplantation was 0.4 gm forming 44.9% of the total weight which increased to 29.5 gm in the second week of April 1979 forming 51.1% of the total live weight.

In all the rafts damage was noticed on the oil barrels used as floats, after 100 to 120 days. Also due to the fast adding of weight of the mussels over the ropes, some of the oil barrels could notwithstand the strong wind and water currents in April 1979. Thus two rafts were seriously damaged and sank in the sea with the entire mussels. Considerable damage also occurred during the cyclone in April. New rafts (rafts) were fabricated and anchored at a depth of 2 m. About 1400 ropes were salvaged and transferred to the new rafts. Subsequently damage was caused to this crop by the mudbank formation in the coastal area.

The harvest was started in the last week of March 1979. A total of 145 ropes were harvested and the yield was 12.5 tonnes. The average yield from a rope of 7 m. length was 86.2 kg. The production per metre length of a rope was 12.3 kg. of mussels within a period of 150 days.

Training in pearl culture (CMFRI/TR/2)*

K. ALAGARSWAMI, A.C.C. VICTOR, A. CHELLAM,
S. DHARMARAJ AND T.A. VELAYUDHAN.

A short-term training Course in Pearl Culture was organised for six weeks during July–August 1979. The organisations which sponsored candidates for training included the South East Asian Fisheries Development Centre, Iloiol, Philippines and Departments of Fisheries of the States/U.T. of Gujarat, Tamil Nadu, Lakshadweep and Andaman & Nicobar Islands. Intensive practical training in pearl culture was given to the candidates.

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* *Please see report under CMFRI Training Programmes also.*

FISHERY ENVIRONMENT MANAGEMENT DIVISION

Physical and Chemical aspects of the shelf and adjacent waters (MBO/ES/1.1)

A.V.S. MURTHY, C.P. RAMAMIRTHAM, D.S. RAO, R. MARICHAMY. G.G. ANNIGERI, K.G. GIRIJAVALLABHAN, S. KRISHNA PILLAI, PON SIRAIMEETAN, S. MUTHUSWAMY, P. MOJUMDAR AND OTHERS.

In the regions noted for seasonal upwelling during monsoon, especially off Mangalore, the surface water temperature is cooled down by about 3 to 4°C, the surface salinity would have increased due to upwelling but for the run off into sea. However, dissolved oxygen got decreased as the low oxygen layer rises up in the process of upwelling. The low values of temperature continued into the post monsoon indicating that upwelling in this area proceeds for a longer period than elsewhere. By December stable conditions existed in the regions of almost all the centres, although the salinity values in general were lower than the post-monsoon.

Progress of work at individual centres are as follows:

Bombay: Sea water samples from inshore waters off Bombay were collected from April 1979 onwards. However, during the southwest monsoon period (June to September) no samples could be collected due to rough sea. Temperature, salinity dissolved oxygen, pH, and plankton biomass were the parameters analysed.

Karwar: Observations on the hydrological conditions for the year ending December 79 were carried out in the Karwar Bay and the parameters namely temperature, salinity, dissolved

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Karwar: Observations on the hydrological conditions for the year ending December 79 were carried out in the Karwar Bay and the parameters namely temperature, salinity, dissolved

oxygen, pH, and nutrients were studied throughout the year. The following table gives the summary of observations of the surface waters of the Karwar Bay.

		Minimum	*Maximum*
Surface temp.	(°C)	27.1 (Aug)	31.4 (Apr)
Salinity	(‰)	14.89 (Aug)	34.22 (Jan)
Dis. Oxygen	(ml/l)	3.47 (Sep)	4.81 (Jan)
Phosphate	(μg. at P/l)	0.19 (Jan)	1.38 (Sep)
Nitrate	(μg. N/l)	0.07 (Aug)	1.83 (Nov)
Silicate	(μg. Si/l)	2.11 (May)	50.78 (Aug)

The pH values in the waters were maintained steadily between 8 and 8.4.

Mangalore: The waters off Mangalore were studied with respect to variations of temperature, salinity, dissolved oxygen, pH, inorganic phosphate and silicate from both the 4 fathom and the 8 fathom stations. Following table gives a summary of the values:

Surface temp.	(C)	21.8 (Sep)	31.5 (May)
Salinity	(‰)	Monsoon	(Aug–Sep)
Dis. Oxygen	(ml/l)	(Aug–Sep)	(Oct–Dec)
Phosphate	(μg. at. P/l)	0.11 (Mar)	0.58 (Sep)
Silicate	(μg. Si/l)	9.25 (Apr)	39.06 (Oct)

Nutrient values as observed in surf collections taken during the monsoon months were quite high. It showed a phosphate content value of about 1.20/ug. at/l during the last week of August and a silicate content value of 92.59/ug. at/l.

It is interesting to note that the inshore hydrographic conditions during August and September were marked by the presence of cooler (23.2°—23.9°C), less oxygenated (3.1—3.3ml/l), more saline (33.3—33.9‰) and more nutritious waters (0.31—0.58/ug.at/l phosphates) and the period coincided with the highest catch of oil sardine for the year.

Calicut: The waters at stations 5 m. and 10 m. bathymetric depths were observed off Calicut with respect to parameters of temperature, salinity, dissolved oxygen, pH and nutrients throughout the year except for a short period June–August due to rough

weather conditions. However, the observations from surface waters from West Hill were observed for the above parameters throughout the year. The observations off West Hill are given in the following table.

	Minimum	*Maximum*
Surface temp.	27.13 (Jul)	31.33 (Mar)
Salinity	27.16 (Aug)	35.48 (May)
Oxygen	3.10 (Jun)	4.60 (Feb)
Phosphate	0.39 (Dec)	1.43 (May)
Nitrite	0.07 (Jan)	0.62 (Jul)
Nitrate	0.49 (Dec)	2.49 (May)
Silicate	7.50 (Dec)	19.38 (Jul)
pH	7.73 (Jul)	8.23 (Dec)

Vizhinjam: Studies were made on the variations of temperature, salinity and dissolved oxygen in the surface waters off Vizhinjam. The maximum surface temperature recorded in the year was 28.20°C and the minimum value was 25.00°C. The fall in temperature was due to the effect of monsoon. The average value of temperature varied from 25.6°C to 27.9°C. The salt content of the waters showed some variation in the year. The highest value was 35.55‰, while the lowest value was 32.50‰. Heavy rains in July caused the lowering of salinity of the waters in the area. The dissolved oxygen content varied from 3.7 ml/l to 5.4ml/l during the year.

Tuticorin: Studies on the hydrology of inshore waters of Tuticorin coast, were continued in the year with the observations on secondary production. Samples were collected both from surface and bottom from important fishing grounds adjacent to new harbour and Pinnakayal. However in the later half of this year, the department launch was not allowed to move in the Pinnakayal area due to restriction posed for all mechanised vessels in favour of country crafts.

The seasonal changes of the surface temperature followed the trend of atmospheric temperature. The maxima were noticed in the year during May '79 and October 1979. The surface salinity was in the range 32.25 to 35.00‰ and the maximum was observed in July '79. The salinity of the bottom samples was recorded in the range 32.31—35.05‰.

The dissolved oxygen content of the surface and bottom samples do not show much variations. Due to heavy rains during November and December '79 there was a sudden fall in pH, ranging from 7.00—7.20. Among the nutrient elements inorganic phosphate and nitrate were estimated, and the values were very low during northeast monsoon months.

Mandapam Camp: Hydrological observations were made in the waters of Palk Bay and Gulf of Mannar with respect to water temperature, salinity, dissolved oxygen, pH and nutrients. The monthly mean values showed as follows:

Palk Bay

	Minimum	*Maximum*
Atmos. temp.	27.3 (Nov)	33.0 (Mar)
Surface temp.	27.5 (Dec)	32.0 (Mar)
Salinity	23.61 (Dec)	35.35 (Oct)
Dis. 0_2	3.7 (Sep)	5.8 (Dec)

Gulf of Mannar

	Minimum	*Maximum*
Atmos. temp.	26.1 (Jun)	32.2 (Mar)
Surface temp.	25.7 (Jan)	32.2 (May)
Salinity	27.41 (Dec)	35.53 (Sep)
Dis. 0_2	4.61 (Mar)	5.4 (Jan)

Madras: During the period under report water samples could be collected off Madras during March, May, June and July and the samples were recorded for their temperature and salinity values.

Waltair: Water samples were collected off Visakhapatnam and off Bheemuipatnam and the samples were analysed with respect to temperature, salinity, dissolved oxygen, pH, inorganic phosphate and silicate. The observations indicated that the surface waters are cooled down by 1–2°C due to the effect of onset of the southwest monsoon. The salinity value ranged from 29‰ to 35‰ during the annual change.

Investigations on the mud banks of the Kerala coast and their influence on fisheries (MBO/MB/1.1)

D.S. RAO, K.J. MATHEW, A. REGUNATHAN AND
V.K. BALACHANDRAN.

During the year 1979, the mud bank formations were reported at Ullal, Kullai, Uppala, Ajanoor-N-Balla, Adakathubail, Kottikulam, Muzhipilangad, Kollam (Near Quilandy), Elathur and Thottapally. It was found that the mud banks in the northern coast of Kerala were all of a transient nature lasting only for a day or two and are formed by the riverine silt and sediments washed into the sea by the rivers during heavy rains in the area. They are always formed to the southern side of the bar mouths in the direction of littoral currents as followed from bar mouths. The mud bank at Thottapally was to the north of the spillway. It was found that the nutrient contents of the mud bank at Uppala were very less compared to that at Thottapally. Phosphate content at Uppala being 0.20μg at p/l compared to 0.82μg at p/l at Thottapally in the same season at the surface. Nitrate content at Uppala was 0.35μg at N/l compared to 1.1 μg at N/l at Thottapally at the surface. But the silicate contents were more at Uppala it being 33.33μg at Si/l compared to 10.2μg at Si/l at Thottapally at the surface during the same seasons. The salinity at Uppala was also very low about 24.29‰ at surface compared to 34.15‰ at Thottapally. In general, the fishery in the mud banks during the year was very poor.

Mariculture Engineering—Development of a low-cost technology for construction of culture ponds (FED/MC/E 1.1)

P. BENSAM, P.S.B.R. JAMES AND S. SHANMUGAM.

With the aim of developing a low-cost technology for construction of culture ponds at M. Camp a programme was taken up in July 1979 for the prevention of seepage. Analysis of soil samples from the Marine Fish farm site at Mandapam Camp during the period has shown that the earth in the region is chiefly an admixture of calcareous particles with a small amount of fine clay and large proportions of shell pieces of *Cerethidea, Meretrix* coral fragments, etc. Surface area in the region was found to contain silt upto a depth of about 3 to 5 cm, followed by a layer

of blackish, decomposed organic matter. With increasing depth, the proportion of mud was found to decrease; and below a level of about 15 to 25 cm, the earth was found to be almost full of sand, with practically no cohesion between the particles. In such a soil substratum, it is essential to construct embankments with considerable precaution, in order to make them durable.

The rate of seepage in ponds newly excavated and without any linings or sealants is about 90 mm/1,000 sq.m/hour. This rate was found to decrease to as low as only about 25% of it in a pond which was subjected to seasoning and consolidation accompanied by rains of the North-East monsoon. In a newly constructed pond lined with polyethylene liner on sides alone, vertical seepage was found to range from 20 mm to 30 mm/1,000 sq. m/hr. The rate of sinking of newly formed embankments was found to be about 30 cm accompanied by about 470 mm rains. Based on the nature of the earth, the inclination of bunds for longer life was determined to be about 45°; and, in order to prevent bunds from collapse caused by wave action, it was found essential to provide clay or turfing material at the level of wave action.

Phytoplankton and primary productivity of the shelf and adjacent waters (MBO/PP/1.1)

P.V. RAMACHANDRAN NAIR, C.P. GOPINATHAN, K.G. GIRIJA-VALLABHAN, P. KARUPPASWAMY, C.V. MATHEW AND V.K. BALACHANDRAN.

Productivity investigations were conducted at Cochin, Calicut, Karwar, Mandapam, Madras and Waltair in the inshore environment using mainly light and dark bottle (oxygen technique) and occasionally ^{14}C techniques.

On the east coast, at Waltair, regular investigations were carried out for the first time. The gross production at Waltair coast was found to vary between 500–700 mgC/m^3/day. The net production also followed almost the same trend with mean respiratory rates varying between 40–46%.

On the west coast especially at Karwar, a wide fluctuation in the values were observed with the minimum of 430 mgC/m^3/day to a maximum of 1734 mgC/m^3/day during the pre-mon-

soon season. At Calicut the productivity studies conducted in a polluted ecosystem where the values were found to vary negatively depending on the intensity of toxicity of the pollutants discharged from the Mavoor Gwalior Rayons Factory. The recovery of photosynthetic activity was observed at about 20 km downstream from the point of impact of effluents during the lean season. At Cochin, the pre-monsoon season recorded a moderate value of 750–800 mgC/m^3/day and a comparatively high value of 1220 mgC/m^3/day during the month of May in the inshore waters.

Productivity and nutrient cycle in the prawn fields around Cochin (MBO/PP/1.2)

C.P. GOPINATHAN, P.V. RAMACHANDRAN NAIR,
V. KUNJUKRISHNA PILLAI, P. PARAMESWARAN PILLAI,
M. VIJAYAKUMARAN, V.K. BALACHANDRAN AND K.K. VALSALA

In order to estimate the potential productivity and nutrient regeneration cycle in the seasonal and perennial prawn fields existing in the estuarine system of Cochin, a new project was started in 1978. Altogether 51 stations were covered in the estuarine system of Cochin from Azhikode in the north to Kumarakam in the south of the Vembanad Lake. Various parameters such as productivity by both ^{14}C and oxygen techniques, hydrological features such as temperature, salinity, dissolved oxygen and nutrients like nitrates and phosphates were studied from these prawn fields. Also the epifauna of the water and benthic fauna of the mud were studied besides analysing the chemical aspects of the mud of these prawn fields.

The data on the various physico-chemical properties of the water and mud studied from the prawn fields had the following salient features.

The measurement of primary production indicated that the entire area of investigation can be classified into 3 categories, the middle region of the estuary where there is direct connection with the sea, the prawn fields showed high rate of production (> 500 mg C/m^3/day); moderate or average values were observed in the interior regions of the northern and southern sector of the estuary and low values (< 250mgC/m^3/day) were observed in

the prawn fields where there is connection with the main land especially the southern regions including the Vembanad Lake. Among the prawn fields, the seasonal fields existing in the northern region of the estuary where the productivity parameters showed an increasing trend.

The hydrological studies revealed that the prawn fields existing in the northern sector of the estuary had higher values compared to the south. The data obtained from chemical analysis of the mud samples showed significant spatial variation in the areas investigated. For the organic carbon in the mud, a negative correlation is observed with the index of benthic productivity which may perhaps be due to higher utilisation of the carbon in the mud by the benthic organisms. So it can be postulated from the data available that regions with higher organic production and benthos and lower carbon content in the mud are better suited for the aquaculture practices.

The productivity indices suggest that an approximate stocking density for a good field with an average carbon production rate of 3 gC/m^3/day would be about 65000 seeds allowing 20% mortality.

Neustonological investigations (MBO/NU/1.1)

P. PARAMESWARAN PILLAI, P.V. RAMACHANDRAN NAIR, C.P. GOPINATHAN, M. AYYAPPAN PILLAI & K.K. VALSALA

A neuston sampler has been designed and fabricated locally. Regular field collections are being conducted at the fishing grounds off Cochin at the 15 and 30 m depth zones. Ichthyoplankton and other zooplankton taxa have been studied separately. Relative efficiency of neuston net and bongo net for the collection of eggs and larvae of fishes and crustaceans is also being investigated.

Secondary production of the shelf and adjacent waters (MBO/PL/1.1)

K.J. MATHEW, K.G. GIRIJAVALLABHAN, S. KRISHNA PILLAI, R. MARICHAMY, PON SIRAIMEETAN, K. RENGARAJAN, C.V. MATHEW, T.S. NAOMI, J.X. RODRIGO AND C.M. ALLIKUNJU.

Zooplankton investigations were carried out at various Cen-

tres such as Bombay, Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam and Madras.

Bombay: A seasonal variation in the abundance of various zooplankton groups has been noticed in the Bombay waters. The copepod population was minimum during October but their maximum abundance was observed during the subsequent two months. There were two peak periods for chaetognaths and fish eggs, one in March and the other in December. The zooplankton biomass was moderate throughout the year except in December when it was 8 ml per 10 min. surface haul.

Karwar: The zooplankton showed two peak periods; one in April and the other in September. The April maximum was due to the presence of a variety of zooplankters, while the September peak was due to the occurrence of enormous numbers of copepodites and copepods. Generally most of the larval forms were found from March to June. Swarms of fish eggs were noticed from September to December. Larval forms of commercially important prawns were present throughout the year.

Mangalore: Relatively higher biomass values were obtained from Mangalore waters except in the month of November. Copepods and cladocerans were the two abundant groups present in the plankton. While copepods dominated the plankton in January–February and November–December period the cladocerans outnumbered all other groups in May and October. The fish eggs were almost uniformly present throughout the year.

Calicut: No regular sampling could be done at this centre. However, in those months from which plankton could be collected the standing crop showed a variation from 3.1 to 7.2 ml per 10 min. surface haul. There was nothing significant to report regarding the composition of the plankton.

Cochin: The distribution of euphausiids in space and time during the year 1967 was worked out based on the zooplankton collected on board *R.V. Varuna* in the shelf waters from Calicut to Karwar. A relationship of *Pseudeuphausia latifrons, Euphausia distinguenda* and *Nematoscelis gracilis* to the thermocline was noticed. Altogether 14 species occurring in the shelf waters are under study.

Tuticorin: The monthly average volume of the inshore water zooplankton ranged between 7.2 and 14.3 ml per 10 min. surface haul. Better catch of zooplankton was made in the post monsoon months of January to August. During the monsoon period (November to February) while the copepods showed less abundance, the fish eggs were numerous. Lucifers were the characteristic item in January and April.

Mandapam: The zooplankton biomass per 10 min. surface haul ranged between 5.9 ml in April and 81.7 ml in July. Young squids were present in the plankton in the months of August, September and November.

Madras: Collections could not be made during the months except March, April, May and July. The zooplankton displacement volume varied between 5.6 and 9.6 ml/10 min. surface haul.

Seaweed Resources Investigations and Culture of economically important seaweeds (MBO/SW/1.1)

V.S.K. CHENNUBHOTLA, S. KALIMUTHU, M. SELVARAJ, M. NAJEMUDDIN AND J.R. RAMALINGAM

Seaweed culture of *Gracilaria edulis* was carried out at Hare Island, CMFRI jetty at Mandapam Camp and Seeniappadharga. At Hare Island, the growth of *G. edulis* was not good due to heavy epiphytic growth and sedimentation. At CMFRI jetty, a total of 4.7 tonnes of fresh *G. edulis* was harvested during the half year. Out of this 2.06 tonnes were used for the introduction of seed material for Lab-to-Land programme and 1.82 tonnes for seaweed culture work at Seeniappadharga and CMFRI jetty at Mandapam Camp. The balance of 820 kg was fried and utilised for experiments on agar extraction and for preparing seaweed recipies. The rate of growth of *Gelidiella acerosa* in the coir nets was very slow. During June all the coir nets at Jetty and Seeniappadharga were removed due to the roughness of the sea.

At Seeniappadharga there was no good growth due to heavy epiphytic growth, sedimentation and grazing by fishes such as *Siganus* sp. At Chinnapalam creek (Rameswaram Island) there was no growth of *G. edulis*. Frames of palmyrah petioles were

tried for *G. edulis* cultivation and these could not withstand wave action. In palmyrah leaf ropes, the growth was found to be fair but they could not stand for more than one month.

During the month of September, 94 coir nets of 5 x 2 m size with *Gracilaria edulis* seed material were introduced in the Gulf of Mannar at CMFRI jetty. The plants showed good growth.

Gelidiella acerosa plants were brought from Kilakarai and attempts were made to cultivate them at aquarium. Portions of these plants fastened to small coral stones using nylon thread and kept in the plasticraft pools with running seawater supply. The plants decayed after two weeks time. Coral stones with attached *G. acerosa* plants collected from natural beds of Kilakarai were brought and introduced in Palk Bay and Gulf of Mannar. The plants showed good growth.

Ecological energetics in the fishing grounds off Cochin (MBO/EE/1.2)

C.P. RAMAMIRTHAM, P. PARAMESWARAN PILLAI, V. JOSANTO, A.G. PONNAIAH, I. DAVID RAJ AND V.K. BALACHANDRAN.

During January, high temperature values recorded at the surface in the region off Cochin, ranged from 29–30°C. The values at the bottom ranged from 27.4 to 28°C. Inversion of temperature between mid-depth and bottom was noticed at the 10 m and 15 m stations. This winter feature has been noticed earlier too. As a rule the salinity values were lower than the post-monsoon period. The values in the whole vertical column ranged from 32 to 33.5‰. Except for the layer over the bottom, the waters were nearly 80% saturated with respect to oxygen content. The oxygen values over the bottom were a bit low ranging from 3.0 to 3.5 ml/l.

Biomass of zooplankton in the fishing grounds ranged from 0.021 to 0.094 ml/l. At the stations located in the marine side of the fishing ground, zooplankton values registered high values which showed fluctuations (3.2 to 9.2 ml/l). The values of zooplankton biomass were relatively low (1.3 to 3.8 ml/l) in the stations of the stuarine side of the fishing ground.

Analysis of the data on the seasonal variations of the trophic groups indicate that carnivorous zooplankton such as medusae,

siphonophores, chaetognaths and copepods occurred in abundance in the marine side of the fishing ground during January and February, and they contributed 36% of the total trophic groups. Predominance of herbivorous forms such as copepods, cladocerans and decapod larvae was evident in the fishing grounds during May (52%). But their species diversity was relatively low. Omnivorous forms occurred more or less in the same proportion in the stuarine areas of the fishing ground.

Benthos of the fishing grounds (MB/BF/1.1)

V. KUNJUKRISHNA PILLAI, C.P. GOPINATHAN, V. CHANDRIKA AND M. AYYAPPAN PILLAI.

In order to find out short-term and long-term effect of the *Salvinia* deposits on the fishing grounds, routine samples of sea water and mud samples were collected from 10, 20 and 30 m depth and bacteriologically analysed in six different selective medias for various kinds of decomposing micro-organisms. An assessment of the proteolytic activity of the bacteria were made by growing them on agars enriched with 4 nitrogenous sources. A nutritional grouping study of the predominant bacteria indicated a significant increase in incidence of bacteria requiring amino acids and a decrease in incidence of bacteria requiring mud extract in the fishing grounds receiving decayed *salvinia* remains. A decline in the water/sediment ratio of proteolytic, amylolytic and lipolytic bacterial population was noticeable in the stations south of Cochin near Chellanum area, where there is a possibility of greater accumulation of organic deposits.

The moisture content of the sediment collected ranged from 10.0 to 10.8% and the pH ranged from 7.23 to 8.71. Within these ranges it was concluded that variations in populations were not caused by variations in sediment moisture or pH. Totally 45 strains (pure cultures) were isolated and the result of the morphological, physiological activities were studied.

From the overall picture obtained by the observations, the fishing ground off Cochin in the depth range of 10 to 20 m. appeared to be more dynamic and productive when compared to other transects investigated in the inshore region. The benthic fauna especially molluscs and echinoderms dominated the faunal representation both in quantity as well as quality.

Mass culturing of plankters (MBO/MCP/1)

P.V. RAMACHANDRAN NAIR, C.P. GOPINATHAN, C.M. JAMES, D.C.V. EASTERSON, GEETA BHARATHAN, V.K. BALACHANDRAN, AND R. PALANICHAMY.

The mass culture programme of both phyto and zooplankters were successfully carried out during the year at various centres especially at Narakkal for feeding the hatchery produced larvae of crustaceans.

Phytoplankton culture:

During the year about 8 species of phytoplankters such as *Skeletonema costatum, Phaeodactylum tricornutum, Chaetoceros calcitrans, Nitzschia closterium, Navicula salinarum, Chlorella virginica, Tetraselmis chuii* and *Isochrysis galbana* were brought from Philippines and maintained in laboratory conditions.

At Narakkal, mass cultures of diatoms and other microscopic algae were continued. Large scale cultures of diatoms like *Thalassiosira subtilis* and *Chaetoceros indicus* were conducted in 20 l glass carbuoys and 500 l glazed tank with artificial light. Altogether 2384 litres of pure culture were supplied to the hatchery for rearing the larvae and for doing some feeding experiments.

Mass culture of rotifers and copepods:

Mass culture of rotifers and copepods have been maintained in 2000 l plastic pools. The rate of harvest of rotifers from the mass production tanks varied from 10 lakhs to 201 lakhs per day for feeding fish/prawn larvae. The daily yield of copepods and copepodites varied from 0.4 lakhs to 25 lakhs. The feeding experiments on *Chanos* fry using rotifers and copepodites showed better growth rate compared to feeding with *Artemia* nauplii.

Mass culture of *Artemia:*

To step up the production of *Artemia* different feeds have been experimented to increase the production of nauplii and cysts. In addition to the Indian strain, which is parthenogenic, California bisexual strain (obtained from SEAFDEC, Philippines) is also mass cultured to understand the growth efficiency and production in different salinities using different feeds.

During the year, the daily harvest of *Artemia* nauplii from the production tanks varied from 0.1 to 2 lakhs. In addition to prawn larvae, *Artemia* nauplii also have been given to *Chanos* fries.

Marine pollution in relation to protection of living resources (MBO/MP/1.1)

P. V. RAMACHANDRAN NAIR, M.S. RAJAGOPALAN, V. KUNJU-KRISHNA PILLAI, C.P. GOPINATHAN, V. CHANDRIKA, P. KARUPPASWAMY, G.G. ANNIGERI, S. MUTHUSWAMY, M.V. PAI, R. MARICHAMY, K.G. GIRIJAVALLABHAN, G.M. KULKARNI AND D. VINCENT.

Investigations on marine pollution were actively carried out at Cochin, Calicut and Karwar. The work at Cochin was mainly on the bacterial population, especially coliform in sediments and decaying deposits of *Salvinia* weeds and overlying waters off Cochin with a view to understand the impact of the effects of these weeds on the demersal fisheries.

A survey of *Escherichia coli* and coliform population in sediments with deposits of *Salvinia* and overlying water was made from inshore waters off Cochin during the year. Totally three sensitive bacterial indicators namely coliforms, faecal coliforms and faecal streptococci were selected in monitoring fishery water quality in the offshore region from 10, 20 and 30 m depth. Bacterial analysis of the three indicators were done in selective medias and the counts were recorded. The means of total coliform/faecal coliform ratios in water were between 8 and 65, whereas they were between 180 and 2808 for sediment samples. This indicates that a large proportion of bacteria in the sediment samples were total coliforms rather than faecal coliforms.

The population of faecal coliforms was between 2 and 24000 and between 2 and 92000 in sediments (MPN/100 ml). Pathogens especially salmonellae were isolated when the faecal coliform concentration was –2000/100 ml. The population of faecal streptococci was between 2 and 1200 and between 2 and 1800 in sediments.

The average mean ratios relating pathogens to indicators were 1 Salmonella to 45 total coliforms, 13 faecal coliforms and

9 faecal streptococci for water samples and 1 Salmonella to 27,198 total coliforms, 485 faecal coliforms and 168 faecal streptococci in sediment samples. Data collected showed that Salmonella isolations could occur with nearly 100% frequency when the faecal coliform concentration was 2000/100 ml.

Generally 100–1000 times more coliforms were detected in the sediment than in the water column. No significant relationship was observed between the organism concentrations and temperature, pH, turbidity and suspended solids content of water. An inverse relationship between the concentration of indicator organism and salinity of water was found; to occur at a 99.9% level of significance. All of the micro-organisms studied were found to be present in greater numbers in sediments than in overlying water often by a factor of several logs. During monsoon period heavy rainfall resulted in large increases in the number of organisms in both water and sediment samples. The results indicate that bottom sediments in the shallow canal systems can act as reservoirs of enteric bacteria which may be resuspended in response to various environmental factors.

Calicut: Monitoring of pollution in the Beypore estuary and the Chaliyar river was continued during the year. Seventy two field trips involving day, night and different tide situations were made during the year. Twenty four hours sampling for water quality, bottom biota and plankters from 7 selected locations along the river and estuary and waste-water for physico-chemical analyses covering all aspects under normal working hours was made during the summer months. Regular weekly samples from 7 stations and from the main outfall at Poolakad were taken every month apart from the 24 hr. sampling.

River flow measurements using a Current Meter was taken up from Koolimadu and Manthalakkadavu during January-February. Intensive fishing using cast nets was made throughout the length and breadth of the river and estuary so as to assess the fishery potentials of the area under investigation.

The river discharge data for the period from 1967 to 1977 was analysed to find out the average annual flow, the average summer flow and the average annual minimum flow in the river

for finding out the ratio of wastewater mixing with the river water.

Live fish *Puntius filamentosus* were caught from the unpolluted waters using cast nets, reared in a large tank in the office campus for one month and conducted bio-assay experiments to find out 96 hr. LC 50 values for these fish.

The cause of mass fish mortality in the Chaliyar river during March-May 1979 was investigated. A preliminary survey to assess the intensity of pollution in the Valappatanam estuary due to the discharge of effluents from the Western India Plywood Industries at Valapattanam was made during the period October December.

The 24 hr. sampling for water quality, bottom biota and plankton organisms at 7 selected locations and 24. hr sampling of waste-water from the Gwalior Rayons Factory showed significant changes in the quantity of pollutants and organisms present. By way of intensive fishing day and night along the river and estuary throughout the year more than 100 species of fish are recorded.

Analysis of river discharge data showed the average annual flow in the river as 143 cm/sec., the average annual summer flow being 19.27 cm/sec. and the average annual minimum flow being 0.64 cm/sec. The 96 hr. LC 50 value obtained for *Puntius filamentosus* was 3.6% requiring a dilution of 1 : 27.5 (waste water: river water). From the river flow data the dilution available in the summer months is calculated to be 1 : 17 52 and flow in the minimum flow period is 1.73 : 1.

Karwar: Under the monitoring programme of pollution studies in the Nallah-Binage, the studies on effect of pollution on the primary production and phytopalnkton was taken up and the actual experiment by light and dark bottle method was started from February 1979. Two stations were fixed for conducting these studies. Hydrographic parameters were also determined.

Investigations on coral reef resources (MBO/CR/1)

C.S. GOPINADHA PILLAI.

Based on data collected in the previous years, a report on the geomorphology and ecology of Kiltan Island in Lakshadweep

was prepared. The salient findings include that the lagoon of Kiltan is without any coral shoals and patch reefs unlike in majority of atolls in the Indo–Pacific. The shallow lagoon is fast getting filled by calcareous sediments which mainly include fragments of calcareous algae, foraminifers, corals and molluscan shells. The percentage of silica is less than 2.5.

The atoll is situated in a cyclonic belt which markedly influence it geomorphology. The island has undergone an elevation to the tune of 1 to 3 m due to a relative change in the land and sea in the geological past. Raised reefs are seen along the shore. Mechanical force of waves generated by occasional cyclonic winds is a major factor that causes the breakdown of corals particularly the ramose forms like *Acropora* and *Pocillopora*.

The coral fauna of Kiltan, as it is known includes 41 species divided among 19 genera. There is a clear cut faunal difference between Minicoy and Kiltan as far as the corals are concerned both in the number of species and in the composition of the various elements.

There exists no natural vegetation in the island. Mangroves are totally absent, a marked feature when compared to many coral islands. The development of a thick sandstone bed at a depth of about 0.5 m is exactly similar to those reported from some of the western Indian Ocean Islands.

The data collected during 1978 from the Gulf of Kutch on the corals and coral formations was processed. There exists no consolidated reefs in the area investigated, but patch growths of corals are found on many wave cut eroded shallow, banks extending from Okha to Pirothtan Island. The most important detremental factor to corals of Gulf of Kutch, at present is the large degree of silting experienced which kills corals. The source of sediments seems to be chiefly of terregenous origin. A detailed study on the coral fauna of Gulf of Kutch is under way.

Ecology of mangrove swamps (MBO/MS/1.1)

M.S. RAJAGOPALAN, G.S. DANIEL SELVARAJ, A. BASTIAN FERNANDO, A. KANAGAM.

Routine observations on the ecological factors in the mangrove areas were carried out at Cochin and Tuticorin. The physico-chemical conditions of the swamps in the Cochin backwater area followed more or less the same pattern as during the previous year. During the summer months, March to June early juveniles of *P. indicus, M. dobsoni* and *M. monoceros* were abundant in the creeks. At Tuticorin also there was no marked variation in the ecological factors during the year when compared with those of earlier years. During summer months, *P. indicus* in the size range 14–20 mm were abundant. The catches of *P. semisulcatus* and mullets in the mangrove areas were less during the year.

During February–March, a special survey of the Pitchavaram mangroves (near Killai, Tamil Nadu) was undertaken. The mangrove vegetation extends to about 1000 ha. in the numerous islets and along the backwater creeks. The vegetation is luxuriant and fairly well preserved.

The common tree forms are *Rhizophora mucronata, R. apiculata, Avicennia marina, A. officianalis* and shrub forms are those of *Excoecaria agallocha, Bruguiera cylindrica, Ceriops decandra, Aegiceros corniculatum* and *Lumnitzera racemosa.* In low saline waters, *Acanthus ilicifolius* predominate along with fresh water weeds and tall grass. The interior of mangrove areas have *Sesuvium* and *Suaeda* intermingling with terrestrial climbers and thorny bushes.

Litter production from the mangroves and their decomposition enrich the swamps and creeks with rich load of detritus. Different species of mullets, peneaid prawns, *Chanos chanos, Etroplus suratensis* and *Scylla serrata* among crabs are common in the mangrove creeks. Physico-chemical conditions and primary productivity estimated in this area show that fish and prawn culture in the area would be very encouraging.

Investigations on marine mammals and turtles (MBO/MM/1.1)

E.G. SILAS, R.S. LAL MOHAN, M. RAJAGOPAL AND A. BASTIAN FERNANDO.

The investigations on the distribution, biology and resources of endangered species of marine turtles, lesser cetaceans and the dugong were continued at Madras, Tuticorin and Calicut.

Marine turtles: At Madras, a hatchery for hatching the eggs of the marine turtle, *Lepidochelys olivacea* has been set up near Kovalam. During January to March 38817 eggs were collected from 309 nests covering the area from Adayar to Kovalam. The eggs which were kept in the pits of the hatchery, hatched after an incubation period of 50–55 days. Of the total number of eggs, 5007 hatched out successfully forming 12.8%.

At Tuticorin the stray catches of marine turtles in bottom set gill net and trawl net operations accounted for 179 turtles as against 400 to 600 during earlier years. There has been a general decline in the fishery for turtles on account of the restrictions imposed on their fishery and also due to the incidence of turtle meat poisoning two years ago. In this region, *Chelonia mydas* is the most common turtle. More than 75% of the turtles caught during the year were females.

Cetaceans: During November 1979, 13 dolphins were stranded near Trichendur. A detailed report on this occurrence is being prepared.

At Calicut 6 dolphins that landed in fishing operations were examined. The size of *Tursiops aduncus* ranged from 101–279 cm and a specimen of *Delphinus delphis* measured 220 cm.

Monitoring of incidental catches of dolphins in fishing operations is being carried out at different centres.

INTER-DIVISIONAL PROJECTS

Survey of prawn, fish and molluscan seed resources (CMFRI/ IDP/1)

E.G. SILAS, K. RENGARAJAN, M. RAJAGOPAL, S. SHANMUGAM, K.M. AMEER HAMSA, R. THIAGARAJAN, G. NANDAKUMAR, S. LAZARUS, K. PRABHAKARAN NAIR, K.J. MATHEW, G.S.D. SELVARAJ, R.S. LAL MOHAN, K.V. SOMASEKHARAN, N. GOPINATHA MENON, DANDAPANI, BASTIN FERNANDO, K.N. GOPALAKRISHNAN AND P. RAMADOSS.

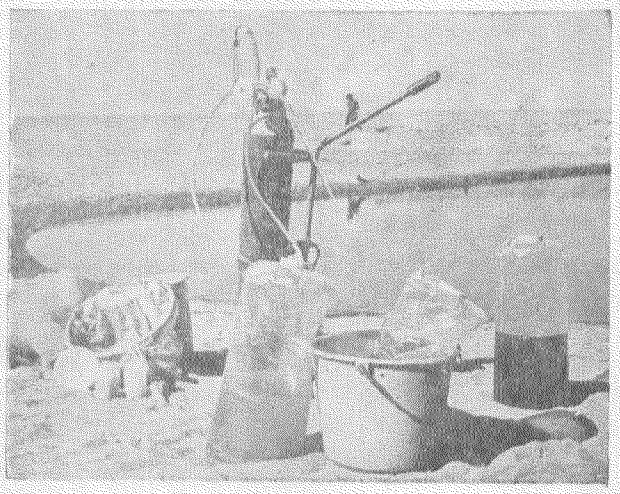
Synoptic diurnal observations lasting 24 hours each, during the fullmoon, newmoon and mid lunar phases, on the abundance of fish, prawn and molluscan seeds, were completed at selected centres at Calicut, Cochin and Vizhinjam in Kerala and at Tuticorin, Mandapam and Madras in Tamilnadu coasts. During the 24 hour periods of observation, samples of seed and data on environmental factors were collected every one hour. A quantitative seed sampler designed by Shri K. J. Mathew for shallow estuarine areas was used for seed collection.

The results obtained from all the centres indicate that the abundance of seeds was related to the lunar phases and the hour at which the collection is made. The following facts emerge from the observations made at the various centres.

Calicut: Between Kasargode and Ponnani the Kavipuzha estuary had the highest concentration (60 numbers per cubic metre) of *Penaeus indicus* seeds in February. Seeds of *Metapenaeus dobsoni* were also present in good numbers in this estuary. *Etroplus* and mullet larvae were abundant in the Chandragiri and Korapuzha estuaries and the occurrence of Chanos fry was recorded in the Poorapuzha estuary.

Nearly 1000 ha. of low-lands suitable for aquaculture were located between Kasargode and Azhikode and about 75 ha. between Azhikode and Badagara. Relevant biological and ecological data were collected from these areas.

Cochin: From the experiments conducted at Cochin it was found that a shallow rectangular scoop net of 1.5 x 1 m made of velon screen was an ideal gear for large scale seed collection. It was found that 50 seeds 20–30 mm in size can be retained per litre, of oxygenated water having 2.5 ml. dissolved 0_2, without adverse effects.



Seed collection kit.

Vizhinjam: Mullet fry, 15–43 mm in size was the most abundant species at the various centres of collection in this region. They occurred in very high concentrations at Perunthura and in lesser numbers at Paravoor, Pananthura and Paritheyoor. 15–42 mm sillago fry were present at Paravoor.

Tuticorin: Creeks, backwaters and estuaries at Valinokkam, Vembar, Vaipar, Kallar, Tiruchendur and Manapad were surveyed. Mullet and prawn seeds (*P. indicus* and *M. dobsoni*) were available in all these centres during all seasons. *P. indicus* was particularly abundant during March–April period, *M. dobsoni* coming next in abundance. Larvae of *P. monodon* occurred in

small numbers at Tiruchendur, Palakayal and Vilinokkam. *Etroplus* seeds were abundant at Palakkayal during May and *Sillago* fry in June. At Vilinokkam and Tiruchendur *Chanos* seeds, 20–94 mm in size, were abundant during April.

Mandapam: The tidal pools at Pamban contained seeds of *P. indicus* at the rate of 504 numbers per sq. metre and *Chanos* fry at the rate of 1780 per sq. metre in February. Mullets seeds were abundant in June. There was rich distribution of prawn, *Chanos* and mullet seeds in the Kanchirangudi backwaters, Chinnapalam creek, Anithurai, Pullamadam backwaters, Athankarai and Devipattanam. *Sillago* seeds occurred in good numbers at Athankarai and Pullamadam in May Seeds of *P. semisulcatus* occurred at Punithurai, Pullamadam, Athankarai and Devipattanam.

Madras: From point Calimere to Kaappakkam larvae of *P. indicus, M. monoceros* and *M. dobsoni* occurred in February and June. Larvae of *P. monodon* (15–25 mm) occurred in good quantities in the upper estuary near Cudallore harbour during June and juveniles of *Sillago* were found in large number in February.

Investigations on fish and shell fish diseases (CMFRI/IDP/2)

S. MAHADEVAN, C. THANKAPPAN PILLAI, S. LAZARUS,
D.C.V. EASTERSON, R. SOUNDARARAJAN AND K. RENGARAJAN

In support of the mariculture programmes of the Institute at Vizhinjam, Tuticorin, Mandapam and Madras, investigations were initiated for monitoring as well as for advising a preventiv and remedial measures on fish and shell fish diseases. The salient features of the work done under the project are given below:

Cochin

Routine monitoring of the occurrence of infective diseases at the various centres of mariculture was undertaken from the bacteriological laboratory of the institute at Cochin. The bacterial counts in the oysters were as follows:

Oyster muscle /gm 10^5 —10^6
Shell fluid 10^3 —10^6 /ml.

Sea water — 10^6 /ml.
Sedimentation tank water 10^7 /ml.
Filtered water 10^4 /ml.

Report was received from the Tuticorin culture centre that *Chanos* and mullets in the culture ponds were afflicted by an unknown disease, soon after the rains. The disease was diagnosed as hemorzhuagic septicemia and the actiological agent was identified as *Pseudomonas aeruginosa.* The remedial and prophylactic measures which were applied, cured the infected fishes and arrested the spread of the disease.

Vizhinjam

During January, February and March fishes such as *Hemirhamphus* and *Sardinella gibbosa* were infected by *Lernaenicus* and *Cymathoe.* The infection has been found to affect at times nearly 90% of the landings of *Hemirhamphus.* Between August and October, large numbers of *Trichiurus* were found to have been infected by the cestode parasite *Eutetrarhynchus* sp. The majority of the fish thus infected were mature females whose ovaries were injected insulting in atrecia of the latter. *Trichiurus* infested with cymathoan and nematode parasites were often encountered.

Mandapam

Eels cultured in recycled water were found to suffer due to excessive slime secreation resulting in 30% mortality in the culture tanks. The cause is under investigation.

In culture tanks having running water, some eels were found to suffer from white patchy skin. Though this condition did not lead to death, the individuals became lean and appeared unhealthy.

The axial skeleton of some of the eels in culture tanks became crippled. A similar condition in other fishes has been known to be caused by a protozoan *Plistophora.*

A few eels in culture died due to swollen intestine, the cause of which is under investigation. Red patches were found to appear on the skin of some of the eels cultured. However, the eels seemed unaffected by this.

National programme of tagging oil sardine, mackerel and prawns. (CMFRI/IDP/3)

P. VIJAYARAGHAVAN. A. NOBLE, M.M. THOMAS. N. GOPINATHA MENON, N.S. RADHAKRISHNAN, P. MOJUMDAR, S.S. DAN AND OTHERS.

The tagging programme was expected to be implemented at Cochin, Calicut, Mangalore and Waltair during the year. Due to unavoidable circumstances this could be done only at Cochin and Calicut centres.

Cochin

The mark–release experiments have been mainly oriented in its present phase, to understand the migratory pattern of prawn/ mackerel/oil sardine of this region. The number of mackerel and oil sardine that could be tagged (2 and 382 respectively) is too meagre for any consideration, the cause of which has been the nonavailability of the research vessel of this centre when the fish were available in this area and vice-versa. For the same reason prawns (97 in number) could be tagged in the sea on a single occasion only.

Tagging operations in the back waters:

The prawn tagging operations at the two backwaters stations, at Bolghatty (within 2 km of the mouth of the estuary) and at Perumbalam (25 km south of the estuary) were continued as in the previous year. However, the tagging at Perumbalam was discontinued in June as the pattern of recovery of marked prawns which were released at this station indicated, as was observed during the last year also, that their migration did not extend beyond 1–2 km of Perumbalam, presumably, as their chances of escaping the innumerable fishing gears (stake nets, cast nets, Chinese dipnets etc) that operated between Perumbalam and the sea were very slender. Between January and June 79, 420 prawns, mainly *Penaeus indicus* and *Metapenaeus dobsoni,* were marked and released, 9.5% of which were recaptured at Perumbalam itself within the first two weeks of their release.

At Bolghatty, between January and December 79, 13,492 prawns belonging to species *P. indicus, M. dobsoni, M. affinis, M. monoceros* and *P. semisulcatus* were marked and released.

They were between 30–80 mm in size. 38% of these prawns were recaptured in the backwaters within a radius of 2 km, around Bolghatty. The rate of recovery was usually greater on days immediately following the release of each batch. Only 6 prawns (all of them *P. indicus*) ie. .04% of the total number that was released at Bolghatty during the year were recaptured from the sea. They were caught by the trawlers operating in the trawling grounds 5–10 km off Cochin. These recoveries occurred between January and August 79 even though the number of prawns that were released from Bolghatty was fairly evenly distributed through all the months of the year. This gives an indication of the period of seaward migration of *P. indicus*. It has however to be born in mind that although the Bolghatty station is within 2 km of the estuary's opening, and the mark release operations have been continuing for over two years, only 6 prawns were recovered from the sea so far.

The rate of growth of *P. indicus* deduced from the recoveries from backwaters was .2—.5 mm/day and from the sea, 1.2 mm/day.

Tagging in the Ashtamudi Lake (Quilon):

A special programme for tagging prawns in the backwaters of Ashtamudi lake in Quilon was organised in November 79. On November 11, 1979, during its exploratory survey of the estuarine reaches of the lake, the tagging team found an area which was abundant in young and juveniles *P. semisulcatus*. Details of this find has been published in *M.F.I.S.*—12, 1979. The tagging experiment was of 13 days duration where 13,664 juvenile prawns were marked and released in the backwaters. Over 90% of the prawns tagged were *P. semisulcatus*, though in small numbers *P. indicus, —latisulcatus, monodon, canaliculatus,* and *M. dobsoni* were also tagged. The total recovery was 1.8% of the number released. The percentage of recovery was found to be slightly greater (over 2%) on many days immediately following each release. Notwithstanding intensive propaganda, the recoveries were entirely from the dipnet and cast net fishery within the backwaters and none from the sea.

Calicut

The tagging operations were confined to the prawns caught in the Korapuzha estuary, and none in the sea. 989 prawns belonging to *P. indicus, M. monoceros* and *P. monodon* were tagged during the year. Of these 23 prawns (2.3%) were recovered. Except 2 prawns which were caught .8 km up the river, all the others were recovered near the bar mouth .5 km from their release. The majority of the recoveries were within the first week of release except three prawns which were caught after 11, 15 and 20 days of liberty. While a very high percentage of error was noted with regard to the information on the size of the prawns recovered, a realistic estimate of 1 to 1.5 mm of growth per day has been made.

Exploration of the fishery resources of the outer continetal shelf and oceanic waters of Indian economic zone. (CMFRI/IDP/5)

S.V. BAPAT, B. KRISHNAMOORTHI, C. MUKUNDAN, M.V. PAI AND R.S. LAL MOHAN.

No work could be initiated in the absence of a fishing/research vessel which could fish in the proposed areas of Indian Exclusive Economic Zone.

Man-made changes on environment—Artificial enrichment of lagoon waters of Minicoy Island (CMFRI/IDP/6)

A.V.S. MURTHY, G. SUBBARAJU, C.S. GOPINADHA PILLAI AND V. JOSANTO.

A preliminary survey was undertaken in November–December 1979 by a team of 4 scientists in the lagoon and adjacent waters around Minicoy Island, as a prelude to assessing technical feasibility of enriching the lagoon waters for mariculture purposes.

Since the Minicoy Island and its environs are among the least studied, the present survey was of a reconnaissance nature, but special attention was paid to hydrography, flow patterns, sediment composition and transport, primary production of the ambient waters and turtle grass and coral reef fishes.

The Minicoy Island is a crescent shaped land mass of 10 km, in length with a maximum width of 1.0 km, and with tapering ends. The lagoon is of 40 sq. km. in area with many coral

shoals. The lagoon is relatively shallow in the southern part where the water completely drains out during the low tide, exposing significant part of the coral growths. Towards the northern side the lagoon is deeper upto five fathoms.

Water samples were collected from 30 stations fixed at specific intervals in the lagoon. In addition, 3 deeper stations were located outside the lagoon. Water samples upto a depth 130 m were collected from outside and analysed for dissolved oxygen and nutrients. Primary production studies were carried out by both ^{14}C and O_2 techniques. The benthic communities were surveyed to an extent with special reference to the sea grass beds wherein their standing crop, O_2 production and consumption and associated fauna were studied. The turtle grass beds of Minicoy are the conventional feeding grounds of *Chelonia mydas*. Preliminary investigations on the zonation and distribution of reef fishes were carried out to study their specific association with reef corals, if any.

O_2 consumption of certain reef fishes—some of them live-baits—was studied with the aid of an oxygen senser with a view to assessing their consumption in relation to ambient O_2 as well as asphyxation level. Six species of reef fishes viz. *Halicoras* spp. (two species), *Chromis, caeruleus*, *Abudefduf* sp. *Spratelloides* sp. and *Apogon* sp. were studied. Reef fishes from corals were collected for laboratory analysis of their feeding habits the result of which will yield certain clues to their natural food, in the event of their being cultured in future.

The results of the experiments and survey are being processed. However, dissolved oxygen measurements indicated higher concentration at the bottom level of the lagoon during day than at the surface. The tides experienced in the region are mainly of semidiurinal type with two highs and two lows in a day with unequal amplitudes. The tidal range is about 0.80 m. with exceptions at the spring tides during November and December when the tidal range even exceeds 1 m. The currents are in general not fast moving in the lagoon area where the maximum speed of 11 cms/sec. had been observed. But in the channels very swift flow with speeds as high as 34 cm/sec. has been noticed. The southern side of the lagoon is shal ow, mostly drained at low tide and holds little water. The coral growth and the asso-

ciated fishes are more luxuriant at the southern half than the central and northern half of the lagoon. There is a general paucity of benthic fauna except corals throughout Minicoy. The sediments are mostly of calcareous origin composed of corals, molluscs, foraminifers and calcareous algae.

A 36 hour observation on current in the western channel (Neru Magu) indicated a mean speed not exceeding 5 cm/sec (8.1 knot), which is over ridden by tidal component of amplitude of the same order of the mean flow. A 12 hours current observation at the main northern channel (Saleh Magu) indicated a mean flow three-times to that at the western channel. The maximum tidal current in this area was 3 times to that in the western region of the reef. The non tidal fluctuations of current at both the places are significant.

Impact of Thanneermukkom Bund on the fisheries of Vembanad Lake (CMFRI/IDP/7)

V.K. PILLAI, S.K. DHARMARAJA, C. SUSEELAN,
K.J. MATHEW, DANIEL SELVARAJ, K.K.P. PANIKKAR
V. JONANTO AND G. RADHAKRISHNAN.

The project work aimed at studying the ecological changes and consequent effects on the fishery resources in the Vembanad Lake were continued in 1979. Physico-chemical parameters such as water temperature, salinity dissolved oxygen and biological parameters like zooplankton and distribution and abundance of fishes were monitored at four stations; two each in the northern zone and southern zone respectively, with emphasis in tracing the special distribution of penaid prawns. During this year the salt water barrier at Thanneermukkom remained closed from January to May.

Hydrography: Water temperature showed a range of 26.5° to 33.0 C° (September and May respectively). Surface salinity varied between 0‰ (July) to 8.92‰ (March). There was a marked decrease in salinity in the two stations of the southern half during January to May due to the clossure of the salt water barrage. The dissolved oxygen values varied between 1.62 ml/L to 6.82 ml/L.

Zooplankton: Zooplankters were represented by medusae, copepods, amphipods, decapod larvae, polychaetes, fish eggs and

larvae. The distribution of zooplankton showed a definite decrease in the southern stations both in quantity as well as quality.

Fishery: Fish samples were collected using a try net operated for 15 mts. Fishery data on the catch composition were collected from the landing centres. The fish samples collected by the try net included: *Ambassis commersoni, A. dayi, A. gymnocephalus, Brachiurus orientalis, Cynoglossus lida, Etroplus suratensis, Eleotris, lanceolatus, Glossogobius giuris, Geres abriviatus, G. oblonga, Leiognathus splendens, L. bindus, Lutianus argentimaculatus Lizza spp., Macrones keletius, Selar malam* and *Triacanthus* sp. Of these, in the order of their abundance, *Macrones keletius, Ambassis* spp. *Cynoglossue lida* and gobiids were dominant in the collections.

The fishes which contributed to the commercial fishery during 1979 in the order of their abundance were, *Etroplus suratensis* (44.3%); Cat fish—*Tachysurus dussumieri, T. subrostratus* and *Macrones keletius*—together (11.8%); *Lutianus* so. (9.5%); *Mugil cephalus* (8.7%); *Scatophagus argus* (5.4%) and flat fishes (4.2%). The fishes which contributed to the minor fishery of the locality were *Megalops cyprincides* (3.8%); *Hemirhamphids* (3.5%); *Pseudosciaenids* (2.3%); *Lates calcarifer* (2%); *Chanos chanos* (1.2%); *Sciaenids* (0.8%); *Wallago attu* (0.5%); and miscellaneous items including carps, gerres and gobiids (2%).

Distribution and abundance of prawns: Four species of penaeid prawns namely *Metapenaeus dobsoni, M. monoceros, Penaeus indicus* and *P. monodon* were recorded in the sample collections besides a few caridians, mainly *Macrobrachium idella.* Of these, *M. dobsoni* and *M. monoceros* occurred on both sides of the barrage, the former species being the most abundant. In the northern zone these prawns were fairly abundant but their number decreased considerably in the southern zone when the barrage remained closed. However, during the monsoon period, *M. dobsoni* was observed in increasing numbers in the southern zone also as a result of active recruitment in the absence of the barrier. *P. indicus* and *P. monodon* were encountered in small numbers along with the above two species in the northern zone during the summer months. These species were not recorded from anywhere in the southern part of the lake beyond the barrage.

Prawn fishery: As a result of the construction of the That nneermukkom salt water barrage and the subsequent reduction in the tidal flow in this part of the lake, the stake nets and dip nets were almost non-functional from south of Pallipuram during the non-monsoon season. However, prawns were caught in small quantities by cast nets and drag nets with *M. dobsoni* as the principal species (51 to 60 mm size) followed by *M. monoceros* and the lobster *M. idella* in lesser quantities. Between January and April larger juveniles of *P. indicus* (110-130 mm) supported a moderate fishery by gill nets in the northern zone. During the monsoon period the stake nets and dip nets were in operation in the middle zone and an average catch of 1.5 kg of prawns were recorded per stake nets during the period. It was understood from enquiry that stake nets were operated only during monsoon period when there is sufficient flow of water. However, it was observed that prawn catch has gone down since the barrage is closed during the summer season from about 25 to 40 kg/net to the present meagre quantity.

Molluscan fishery: During the year 14 samples were collected weighing about 30 kg and numbering about 6000. Considering their numerical abundance, the following trend was observed: *Villorita cornucopia* (1838): *Villorita cyprinoidea* (877); and *V. cochinensis* (371). On the western end of Thanneermukkom the population of *Villorita* was estimated as 100-150/sq. m and on the northern side it was 175-250/sq. m On the southern side of the barrage most of the population consists of subfossils and dead shells only.

From all these observations, it was evident that the ecological changes resulting due to the operation of the salt water barrage is reflected in the ecosystem being affected in various degrees at the different trophic levels from plankton to fishes and prawns.

Nutrition and ecological energetics in prawns. (CMFRI/IDP/8)

P.V. RAMACHANDRAN NAIR, D.C.V. EASTERSON, M.S. MUTHU, M. RAJAMANI, A.G. PONNIAH AND C.V. MATHEW.
Investigations at Narakkal (Cochin)

In the culture of *Penaeus indicus* in backwater areas it has been the experience that with the lowering of salinity and rise

in temperature in the environment the cultured stocks have necessarily to be harvested before the onset of a condition known as "softness" among the prawns which invariably lead to their mortality. Experiments were initiated to determine the cause of "softness".

Experiments on the effect of feeding with protein rich food, with carbohydrate food and of starvation performed on these prawns indicate that—(1) starvation did not affect them during the initial 6 to 8 days, (2) that the prawns become "seemisoft" after 14 days of total starvation and fully soft after 28–29 days, (3) that the prawns which become "soft" after 28 days of starvation recovered complete health on being fed with prawn meat for 14 days whereas they did not recover on being given carbohydrate diet, and (4) that the inadequate availability of proteinous food in the ecosystem which is probably related to the prevailing low salinity of the environment. Could be the cause of "softness".

Biochemical analysis of the healthy and "soft" prawns gave the following results:

		HEALTHY	SOFT
1.	Dry wt. as % of wet wt.	19.61—26.91	14.53—20.74
2.	Total Nitrogen, % of dry wt.	13.33—15.57	13.39—15.17
3.	Protein-Nitrogen, %of dry wt.	11.12—12.33	9.87—11.99
4.	Non–protein Nitrogen, % of dry wt.	2.41— 3.10	3.18— 4.18
5.	Non–protein Nitrogen, % of dry total Nitrogen	17.38—20.37	20.96—30.72
6.	Protein value	61.13—74.94	69.50—78.94

Investigations at Kovalam (Madras)

Experiments were performed to study the effect of different environmental factors on the food preference, feeding rate, moulting frequency and growth rate of phyllosoma larvae of the spiny obster *Panulirus homarus.*

Of the different food items such as live copepod larvae, artemia (*Artemia salina*) larvae, minced prawn larvae, dried and

powdered clam meat and compounded feeds offered, the phyllosoma accepted only the nauplii of artemia. With this food the phyllosoma could be reared up to 60 days during which they attained the 6th stage of development after undergoing 8 moults. By increasing the density of artemia nauplii offered as food, form one/60 ml of water to one hundred/60 ml, the consumption of nauplii by phyllosoma increased at the rate of 0.5 to 27.8 nauplii per day. While the density of food offered showed positive correlation (PO.65) with its consumption, negative correlation (PO.001) was observed with the moulting frequency.

Experiments on the effect of natural light, flourescent light and total darkness on the feeding and moulting frequency indicated that feeding was most intense and that moulting frequency lessoned in natural light. The phyllosoma could not be reared beyond 60 days as the feeding declined, presumably due to changes in their food requirement and as they became easily vulnerable to attacks of citiates, nematodes and other parasites. The experiments are being extended to culturing phyllosoma in larger (300 L.) tanks.

Experiments on the effect of eyestalk ablation on juvenile lobster (*P. homarus*) on their feeding, moulting frequency and growth indicated that eyestalk ablated lobsters consumed 2–3 times more food than the normal ones and that this was accompanied by the shortenning of the intermoult period and increase in the length and weight per moult. It was also observed that clam meat was preferable to compounded food since the latter contaminated the water more easily resulting in the death of the lobsters reared.

Studies on the ecology, production and economics of crop-marine prawn/fish culture in different ecosystems. (IDP/11)

P.V. RAMACHANDRAN NAIR, P.V. RAO, C.P. RAMAMIRTHAM, N.N. PILLAI, V.K. PILLAI, C.P. GOPINATHAN, M. KATHIRVEL, K. NARAYANA KURUP, S.K. PANDIYAN, A. LAKSHMINARAYANA, M. RAJAMANI, S. AHMAD ALI AND OTHERS.

Experimental prawn culture was undertaken in a seasonal paddy field at Narakkal and in perennial paddy field and its feeder canal at Pallipuram after the paddyhas been harvested.

Between December 1978 and January 1979, after suitable preparation of the fields, 52901 juveniles (20–78 mm size) of *Penaeus indicus* were stocked in the Narakkal field and 31.927 numbers 21–25 mm in size in the Pallipuram field and its feeder canal. Up to February 79 the prawns in both the fields registered a steady growth rate, the stock at Narakkal attaining a modal size of 111–115 mm and the stock at Pallipuram attaining a modal size of 81–85 mm in the field and 131–135 mm in the feeder canal.

After this stage the growth rate in both the places declined, presumably due to heavy competition among the now grown up prawns. Hence the density of the stocks in both the fields was reduced by the removal of a portion of the populations. This measure slightly accelerated the growth of prawns in the Narakkal field which attained a size of 108–133 mm by March 79. But thereafter the growth and the number of prawns in this field registered a slower rate. Therefore the entire stock at Narakkal was harvested at the end of March 79.

The artificial reduction of the density of the stock, did not help in accelerating their growth rate in the Pallipuram field. The condition of the population in this field showed marked decline and the condition of "softness" began to manifest among the prawns. This might have been due to the high (37.0° C) temperature recorded during this period. Hence the stock was harvested by March end.

The environmental factors which were being monitored throughout the experiment showed that the decline in the growth as well as the healthy condition of the prawns was mainly due to higher temperature.

INTER - INSTITUTIONAL PROJECTS

Fish/prawn feed development for intensive culture (IIP/1)
SYED AHMED ALI AND M. VIJAYAKUMARAN

(in collaboration with Central Institute of Fisheries Technology)

At Narakkal, five experimental feeds, designated Feed Nos. 5–9, were prepared with protein content ranging 20–46.5%, using different proportions of *Squilla* powder, groundnut cake, tapioca powder, mineral mix and vitamin mix, to find out the protein requirement in the diet of the juveniles of prawn *Penaeus indicus*. The growth of prawns increased with the increase in the dietary protein upto 42.9%. In the case of control feed (fresh clam meat), frequent moulting, mortality and cannibalism were observed. Based on these results, four more feeds, Nos. 11–14, were prepared with prawn waste, fish meal, groundnut cake and tapioca for field culture of *P. indicus* and feeding experiments are being continued.

For mass rearing of post-larvae of prawn, two feeds, No. 3 and L, were formulated using clam meat and *Squilla* powder, yeast, groundnut cake, tapioca, mineral and vitamin mix. The post-larvae had grown in 17 days from 6 mm to 18 mm with 71% survival with feed No. 3. The corresponding figures with feed L are—in 23 days, 6.3 mm to 23.5 mm and 90% survival. Best growth and survival rate are obtained at the stocking density of 1200 post-larvae per sq. m.

Feeding experiments with dry feed formulations for rearing larval prawn (from protozoea onwards) did not give encouraging results.

Experiments on milk fish and mullet fry with feed consisting of fish meal, groundnut cake, rice bran and tapioca in wet

dough form gave the following results: milkfish—growth from 30 mm to 72 mm in 60 days; mullet—growth from 0.53 g to 0.64 g in 35 days.

At Kovalam, experiments on feeding of phyllosoma larvae of the lobster *Panulirus homarus* with seven feeds using fish meal, clam meat, prawn waste, rice bran, groundnut cake and tapioca showed that these are not suitable. But juveniles and adults accepted these diets.

Operation of conventional and experimental 'Dol' nets (IIP/2)

S.V. BAPAT, A. KURIEN AND M.Z. KHAN.
(in collaboration with Central Institute of Fisheries Technology)

No work could be carried out from Bombay as the fabrication of the experimental gear could not be done as per design obtained from CIFT.

At Veraval, in all 11 experimental operations were carried out from Navabandar, the selected landing centre—two operations each in February, April, October and November and 3 operations in March. The catch per haul was less, to the extent of 37.8% compared to the conventional net. The average size of the catch showed encouraging results, varying between 99–146 mm as against 77–136 mm in the conventional net. The average weight of 100 fish from the experimental net varied between 1.443–2.500 kg as against 0.614–1.380 kg in the conventional net. These observations clearly indicate that the experimental net is operating effectively eliminating the small size fish.

In the overall catch, the experimental net showed a decline by about 850 kg which is mainly accounted for by small size Bombay-duck, non-penaeid and penaeid prawns and *Coilia dussumieri*. But it also accounts for better landing of *Ilisha filigera* and *Stromateus argenteus*. It would be interesting to evaluate the returns from the catch also to understand the economics in recommending the improved design of the 'Dol' net.

Product development and quality control of molluscan products (IIP/3)

K. ALAGARSWAMI, K.A. NARASIMHAM, R. SARVESAN, A. CHELLAM, P. MUTHIAH, P.V. SRINIVASAN, P.S. KURIAKOSE AND K. SATYANARAYANA RAO.

(*in collaboration with Central Institute of Fisheries Technology*)

Programmes were taken up on mussels, oysters and clams. The biochemical composition of the blood clam *Anadara granosa* from culture pens and natural beds at Kakinada was studied. The cultured clams gave a fat content of 1.63% and protein 9.6%, whereas those from the natural beds gave the values of 1.26% and 11.4% respectively. Except in September, the condition index of cultured clams was invariably higher than that of wild clams.

Meretrix casta ovum of Sambhavi estuary near Mangalore showed average total solid content of 20.5% and 21.06% wet weight in August and September respectively. The average lipid content in August was 18.16% dry weight. The protein content of *Villorita cornucopia* at Cochin ranged 49.27–56.67% during August–October.

Purification tanks were constructed at Tuticorin and Calicut for treating oysters and mussels respectively by chlorination process. Different types of oyster preparations were made at Tuticorin and served to invited people. This has resulted in a moderate demand for oysters in the area. Experimental canning of oyster meat was done at Tuticorin and of mussel meat at Calicut. Marketing potential was explored for oysters and mussels. Material was given to CIFT for the processing work.

Economics of marine fisheries in the Calicut area (IIP/4)

K. ALAGARAJA AND K.K.P. PANIKKAR.
(*in collaboration with Indian Agricultural Statistics Research Institute*)

The objective of the project is to study the impact of introduction of small mechanised fishing vessels on the socio–economic conditions of rural population in the coastal area near Calicut.

In order to carry out this study, suitable schedules to collect the relevant data have been developed. The collection of data was planned in two phases. The first phase was concerned with the complete census of all the families in Puthiappa–Puthiangadi area and the fisherfolk families in Elathur village. In the second phase a sample of households representing all types of occupations will be selected for detailed study.

The first phase of the study has already been completed. Filled–in schedules have been tabulated and analysed. Suitable tables have been prepared on size of the family, occupation details, active fishermen, possession of fishing equipments, indebtedness and income levels. Based on this information a preliminary report has been prepared.

SPONSORED PROJECTS

One of the significant developments that has taken place in the Institute in recent years has been the implementation of Sponsored Projects on specific problems suggested by development agencies. During 1979 two such projects funded by the Marine Products Export Development Authority were taken up for implementation by the Institute and the progress achieved during the year is given below:

(i) On assessment of fry resource of cultivable penaeid prawns at selected centres in Kerala and Karnataka.

This project formed a part of the project on *"Brackish water shrimp farming"* operated by the MPEDA. The area of investigation covered all the important estuaries and backwaters from Karwar to Quilon. The estuaries of important rivers and the backwaters in both Karnataka and Kerala were surveyed during the year regularly from March 1979. Data on seed resources and environmental parameters relating to the abundance of seeds in different localities were regularly collected.

The seed resource in the estuaries of the project area was constituted by *Penaeus indicus, P. monodon, P. semisulcatus, P. merguiensis, Metapenaeus dobsoni, M. monoceros* and *M. affinis.* Of these, *P. indicus* and *M. dobsoni* were observed to form the major portion of the seed resource. The area wise and species wise relative abundance of prawn seeds obtained from different centres are being studied.

(ii) Elver resources survey and eel culture

This project was taken up for implementation from the middle of November 1978. During the elver season from November 1978 to May 1979, 42 elver collection centres in Tamil Nadu were

surveyed, out of which elvers could be collected from 16 centres. A total of 31,590 numbers of glass eels and elvers ranging in size from 55 mm to 100 mm were collected during the period. Centres such as Sreevaikundam Anicut, Lower anicut, Pillaimadam and other places around Mandapam yielded the bulk of the elver collections made during the year.

Experiments conducted on the transportation of elvers in suitable PVC or polythene containers to different places with in a duration of 24 hours have shown good survival rates.

OPERATIONAL RESEARCH PROJECT

S.J. RAJAN AND TECHNICAL ASSOCIATES

The Operational Research Project of the Central Marine Fisheries Research Institute on "Blending Sea Farming with Traditional Capture Fisheries", which was started at Kovalam, a fishing village 35 km south of Madras in mid 1978, has maintained steady progress during 1979. In addition to the main activity of open sea mussel culture, other gainful and useful programmes like prawn seed collection for distribution and laying of Nutrition Garden were successfully initiated. Inspite of severe cyclones which resulted in some early set-back to the main programme, alternate methods were found out to successfully get a mussel harvest from the open sea raft. The involvement of the fishermen youth was maintained throughout the year. The overall impact on the participant youth and villagers has been good.

One of the serious constraints for development of musse culture in this region is the frequent cyclonic weather which causes heavy damages to the rafts. In order to obviate this difficulty a special semi-submerged raft has been designed by the unit. Successful trials have been made by this raft. Since the raft is kept submerged the heavy waves caused by cyclone passed over it without causing damage to the mussel culture raft suspended from the buoys. This raft has been fabricated with locally avaiable material and is very simple for construction using cheap material. This raft has attracted the attention of many mussel farming groups of the area.

In order to popularise mussels among the people of the area, functions have been organised where hygienically prepared mussel dishes have been distributed among the people. These functions have been quite successful and was much appreciated by Shri C. Chellappan, IAS, Director of Fisheries and Shri Thirumal, IAS,

Commissioner and Secretary of Tamil Nadu who had attended the function. The project has also organised training groups among local youths for imparting practical training in prawn seed collection, identification, handling, packaging and transportation. In connection with the I.C.A.R. Golden Jubilee, the Operational Research Project has organised Nutrition Garden Programme in the Kovalam fishing village with the participation of the students and teachers of the village school. Necessary infrastructure requirement for the development of garden such as seeds, seedlings, manures and garden earth etc, were distributed. This programme was very popular particularly because the harvested vegetables were distributed to the school children a nd nearby Balawadi.

Impact of the first stage of the programme among the fisher youth of the selected village, Kovalam, has been very good. It is proposed to give more stress to the marketing aspect of the mussel in the next phase of this programme as facilities for marketing the mussel is at present scanty.

EXPERIMENTAL TRANSFER OF TECHNOLOGY

Lab-to-Land Programme

E.G. SILAS, K. ALAGARSWAMI, P.V.R. NAIR, P.V. RAO, K.V.N. RAO, K. ALAGARAJA, V. BALAKRISHNAN, M. KATHIRVEL, M.M. KUNJU, P.S. KURIAKOSE, C.V. MATHEW K.J. MATHEW, P.P. PILLAI, K. RENGARAJAN, T. THOLASILINGAM, K. RANGARAJAN, K.G. GIRIJAVALLABHAN, P.S.B.R. JAMES, V.S.K. CHENNUBOTLA, K. NAGAPPAN NAYAR P. MUTHIAH, M.E. RAJAPANDIAN AND OTHER SCIENTIFIC AND TECHNICAL STAFF.

The Lab–to–Land Programme was implemented at the Institute from the beginning of 1979. It was considered that the technologies of coastal aquaculture which have been developed at this Institute were ideal for transfer to the fishermen who are landless labour and small and marginal farmers in the coastal sector. The programmes which were taken up were; (1) intensive prawn culture (2) polyculture of prawns and fishes (3) mussel culture (4) edible oyster culture ()5) seaweed culture.

The following six centres were selected for implementing the Lab–to–Land Programme: Cochin, Quilon, Calicut, Tuticorin, Mandapam Camp and Madras. A Harijan Society consisting of 122 families at Valappu in Vypeen Island was adopted for intensive prawn culture. 15 individual families belonging to the marginal farmers group were identified in Quilon District for the culture of prawns and fishes. 30 fishermen engaged in mussel picking were selected at Elathur near Calicut for mussel farming.

15 fishermen families were adopted for oyster culture at Tuticorin. 20 fishermen families in the villages around Mandapam were involved in seaweed culture. 50 Harijan families at Muttukkad were adopted for prawn culture and 50 fishermen families were selected for mussel culture at Karikkattukuppam. In all 302 families were involved in the Lab-to-Land Programme of this Institute.

The bench-mark survey of the families was conducted as a baseline study of the socio-economic conditions of the selected families which would form the basis for the impact analysis at the end of the programme.

All the farmers selected under the programme were trained in the respective technologies in a phased manner. Training programmes were also conducted by the Krishi Vigyan Kendra in Mariculture. The critical inputs allowed by the ICAR were found insufficient to cover the coastal aquaculture programmes. It was later expanded to include additional critical inputs essential for the implementation of the programme.

The programmes at different centres made steady progress during the year. At Valappu 0.84 hectare of marshy land was prepared as prawn farm and prawn culture was taken up from March 1980. In May the first harvest was taken which yielded a harvest of 315.8 kg of *P. indicus* and 3.1 kg of *P. monodon* accounting for a revenue of Rs. 4680.75. Ecnouraged by this, the Harijan Society was interested in expanding prawn culture in their land. The Institute also assisted in "pokkali" paddy culti-

vation during the monsoon period. Besides, the above major programme at Valappu the Institute also assisted three individual farmers in prawn culture during the year. In one field at Ezhikkara a harvest of 98.2 kg of *P. indicus* and 1.1 kg of *P. monodon* valued at Rs. 2033.86 was taken. The programme in Quilon District made considerable progress and harvests were taken at different times. Being a new area for prawn farmng, there were environmental problems which were identified for research input. At Calicut rafts were floated by the farmers for mussel farming and about 600 ropes were seeded with young mussels for rearing. At Tuticorin the fishermen established an oyster farm in Tuticorin Bay in May 1979 which was stocked with seed oysters provided by this Institute. The seaweed farmers at Mandapam Camp has also taken a harvest of 1.4 tonnes of *Gracilaria edulis* from the nets they had maintained in the Gulf of Mannar. The seaweed farmers were also trained in the post-harvest technology for converting the produce into agar-agar for realising maximum returns from the product. Mussel farming at Karikattukuppam did not give intial success due to the non-favourable sea conditions. However a small harvest of mussels was taken and the fishermen realised for the first time the utility of mussel as human food. As a subsidiary programme prawn culture was taken up in a small pond area adjacent to the village. At Muttukkadu which is close to Karikattukuppam the programme on prawn culture could not be taken up due to non-availability of suitable land area.

As a part of the Lab-to-Land programme the Institute took up intensive extension and publicity work for spreading the message of coastal aquaculture. Simple extension literature was issued on the technologies. The scientists participated in television and radio programmes. The Films Division of the Government of India took Newsreels. The scientists also wrote articles for newspapers. Exhibitions were organised at different centres.

As a mid-term appraisal, a Workshop was organised in July 1979 at Cochin and Mandapam with the participation of the scientists, fish farmers and the agencies implementing IRDP/ SFDA programmes. Based on the four-day discussion at the workshop, an action plan was evolved for implementation at this Institute. The Proceeding sof the workshop were published as *CMFRI Special Publication* No. 6 in August 1979.

The work carried out under the Lab-to-Land programme during the year has created a considerable impact in the areas of operation. A general awareness has been created in Vypeen Island of the economic advantage of prawn culture and more farmers have come forward to adopt the technology and for training. In Quilon District where there was no prawn farming practice earlier, the results of the Lab-to-Land programme have created an interest in the peopie which resulted in organising mobile training courses in prawn culture in the area with the asstance of the Block Development officials. Similarly the fishermen of Elathur village have realised the production potential of mussel farming.

EDUCATION AND TRAINING

One of the main objectives of the Central Marine Fisheries Research Institute being provision of development support for the balanced growth of industrial, artisanal and culture fisheries through transfer of technology, dissemination of information, education, training and extension, concerted efforts were made since 1978 to impart education and training in different subjects relating to marine capture and culture fisheries through regular as well as *ad hoc* programmes at different levels. The regular programmes conducted during 1979 included training in marine prawn culture, pearl culture, edible oyster culture, under water investigation by SCUBA diving, and in fishery resources assessment and population dynamics. Institutional training to fish farmers was offered under the Krishi Vigyan Kendra for mariculture at Narakkal. Besides these, a scheme entitled "Centre of Advanced Studies in Mariculture" under the ICAR/UNDP Project on "Centre of Advanced studies for post-graduate Agricultural Education and Research" was initiated from June, 1979 at this Institute for imparting post-graduate education in mariculture.

1. Training in Marine Prawn Culture (CMFRI/TP/1)

P. VEDAVYASA RAO, M.J. GEORGE, P.V.R. NAIR, K. ALAGARAJA, M.S. MUTHU, M.M. THOMAS, N.S. KURUP, N.N. PILLAI, C. SUSEELAN, C.P. GOPINATHAN, M. KATHIRVEL, S.K. PANDIAN, M. RAJAMANI, A. LAXMI NARAYANA, SYED AHMED ALI, C.M. JAMES, S. LAKSHMI, C. NALINI, K. CHELLAPPAN, JACOB D. EAPEN, (COCHIN), M.M. KUNJU (CALICUT) AND S. RAMAMURTHY (BOMBAY)

22 Research Scholars who were recruited to work under the Sponsored Project "Assessment of fry resources of cultivable

penaeid prawns at selected centres in Kerala and Karnataka", were trained in theoretical and practical aspects of identification of larvae, post-larvae and juveniles of commercially important prawns and fishes, as well as in the collection and analysis of seed samples for qualitative and quantitative studies for a duration of 2 weeks. The course included group discussion, field visits and practicals.

Names of Research Scholars of the Sponsored Project on 'Assessment of Fry Resources of Cultivable Penaeid Prawns at selected centres in Kerala and Karnataka':-

1. Dr. V.S. Somavanshi
2. Shri V.S. Chandrasekharan
3. Shri Vijayakumar Rathod
4. Shri V. Selvaraju
5. Shri S. Adyapatham
6. Shri T.K. Rajmohan
7. Shri M.S. Ravenkar
8. Shri S. Sankar Raj
9. Shri K.V. Sathiaraj
10. Shri B.S.S. Prasad
11. Shri P. Gunasekharan
12. Shri J. Sunninayakam
13. Shri O. Kumaresan
14. Shri A. Ramalingam
15. Shri D. Samuel
16. Shri Y.C.T. Sam Raj
17. Shri K. Sathyanarayana
18. Shri V.I. George
19. Shri A.R. Manoharan
20. Shri M. Chandrasekharan
21. Shri S. Vasudevan
22. Shri M. Vaitheeswaran

2. Training in Pearl Culture (CMFRI/TR/2)

K. ALAGARSWAMI, (COCHIN), K. NAGAPPAN NAYAR, S. MAHADEVAN, A. CHELLAM A.C.C. VICTOR, S.K. DHARMARAJ AND T.S. VELAYUDHAN (TUTICORIN)

The training in pearl culture offered during the year was second in the series of short-term programme. It was of six weeks duration. Nine candidates* one each from the South East Asian Fisheries Development Centre, Iloilo, Philippines, the Fisheries Department of Gujarat, and Tamil Nadu, and from the Andaman and Nicobar Administration, two each from the a Lakshadweep Administration and the CMFRI underwent training. The course was directed to provide practical training mainly in oyster surgery for production of cultured pearls and farm maintenance, and included 30 units comprising of 19 units of practicals in oyster surgery, 5 in farm maintenance, 2 in pearl collection, 2 on basic anatomy and 2 on the general subject relating to pearl oyster, its fisheries, ecology, seed procurement and production and bor-

ing and fouling organisms affecting the culture system. The programme also included group discussions and study tours to nearby centres of fisheries and mariculture interest.

Names of candidates who attended Training in Pearl Culture:

1. Mr. Emeterio L. Borlangan	Fisheries Technician, SEAFDEC, Tigabauam, Iloilo. Philippines
1. Shri M.C. Muthu Koya	Fisheries Officer, Union Territories of Lakshadweep.
3. Shri M.K. Syed	Field Assistant, Union Territories of Lakshadweep.
4. Shri M. Ramakrishnan	Sub Inspector of Fisheries, (Fishing Harbour) Dept. of Fisheries, Tamil Nadu
5. Shri M.M. Jani	Sr. Research Assistant, Dept of Fisheries, Sikka, Gujarat.
6. Shri D. Sivalingam	Scientist, Regional Centre of CMFRI, Mandapam Camp.
7. Shri R. Thangaveiu	Jr. Technical Assistant, Research Centre of CMFRI Tuticorin.
8. Shri M. Manivasagam	Field Assistant, Research Centre for CMFRI Tuticorin.

3. Training in Edible Oyster Culture (CMFRI/TR/5)

K. NAGAPPAN NAYAR, S. MAHADEVAN, K. RAMADOSS, M.E. RAJAPANDIAN, N. SUNDARAM AND C.T. RAJAN.

The main thrust of this training programme was to transfer the technology of culture of edible oyster to small scale and marginal fishermen so as to propagate and promote this field among

them. 15 fishermen were selected and trained during April–May, 1979 and subsequently in August 1979. After the training, the fishermen were actively involved in the culture of about two lakhs of oysters by following the 'rack' culture technique. The products are expected to be harvested in June–July, 1980.

Group of technicians trained in SCUBA diving

An *ad-hoc* training course in edible oyster culture was also offered to a batch of students from the University of Madras, who are undergoing the Post–graduate Diploma course in mariculture.

4. Training in underwater investigations by SCUBA Diving (CMFRI/TR/4)

S. MAHADEVAN AND OTHER STAFF OF TUTICORIN RESEARCH CENTRE OF CMFRI, TUTICORIN.

In under-water investigations, diving with SCUBA has received considerable importance as it provides direct scientific information and data from the seabed. This programme envisages to train the Scientists and Technicians in the principles and methodology of SCUBA diving for a period of 8 weeks. As part of the programme, preliminary training was given to six Scientists/

Technical staff*/of the Institute on swimming, use of masks and fins, snorkeling and free floating. Training with diving equipment will be continued in the fair seasons of 1980.

(Staff trained in SCUBA diving)

1.	Shri A. Chellam	Scientist 'S'—1	Research Centre of CMFRI, Tuticorin
2.	Shri A.C.C. Victor	" 'S'—1	"
3.	Shri A. Dharmaraj	" 'S'	"
4.	Shri T. S. Velayudhan	" 'S'	"
5.	Shri D. Bosco Fernando	Fieldman	"
6.	Shri R. Athi Pandyan	"	"

5. Training in Fishery resources assessment and population dynamics (CMFRI/TR/6)

K. ALAGARAJA, T. JACOB, G. VENKATARAMAN, S.K. DHARMARAJA, K. NARAYANA KURUP, M. SRINATH, K.K.P. PANIKKAR, R. SATHIA DAS, K. BALAN, B. PRASANNA KUMARI, K. VIJAYALAKSHMI, C.R. SHANMUGAVELU, M.G. DAYANANDAN, G. BALAKRISHNAN, VARGHESE PHILIPOSE, G. KRISHNAN KUTTY NAIR, VARUGHESE JACOB, P. SIVARAMAN, V. RAJENDRAN, V.P. ANNAM, A. KANAKAN, S. HAJA NAJEEMUDDIN, C.J. PRASAD, T.A. SANKARANKUTTY, K. SANTHAKUMARI AND P.L. AMMINI.

The nature of our marine fisheries involving multiple species, diversified crafts and gears, scattered fish landing centres all along the coastline makes the assessment of resources complicated. Similarly, the characteristics of the constituent species, such as, prolonged spawning season, fast rate of growth, relativeiy short life span and the seasonal migration, as well as the mortalities caused by the abiotic and the biotic factors make the investigations on population dynamics very complex. These aspects need careful analysis of data involving judicius statistical application to arrive at reliable conclusions and recommend measures for rational management of the resource. Lack of trained personnel in this field has been felt quite often and hence the Institute started a regular training programme on the subject in 1978 for the rsearch and Technical personnel engaged in fisheries research, education and development Institutions in the country. In 1979, twelve candidates* sponsored by the different maritime

states, Agricultural Universities and the biologists of the Institute underwent a training course of six weeks duration on 'Fishery resources assessment including population dynamics'. The content of the course included a general background of the major fisheries; statistics involving summarisation of univariate data; concept of probability; bimodal, poisson and normal distribution; bivariate data with concepts of correlation; regression and fitting of curves using methods of least squares; multivariate data; tests of significance; analysis of variance and sampling techniques. Population dynamics covered estimation of growth, mortality, growth and yield curves and economic evaluation of aquaculture.

***Names of trainees who attended the training programme in fisheries statistics and population dynamics at C.M.F.R. Institute, Cochin during November-December 1979**

1.	Shri P.M. Dixit	Assistant Statistician, Dept. of Fisheries, Bombay, Maharashtra.
2.	Shri C.K. Vijayan	Directorate of Fisheries, Andamans & Nicobar Administration, Port Blair.
3.	Shri A.C. Mehta	Office of the Dy. Director of Fisheries Mangrol, Gujarat State.
4.	Shri Y.H. Shah	Fisheries Officer, Office of the Asst Director of Fisheries, Veraval, Gujarat.
5.	Shri M.P. Unadkat	Office of the Commissioner of Fisheries, Ahmadabad.
6.	Shri K.S. Uduppa	College of Fisheries, Mangalore.
7.	Shri M.S. Rajagopal	Scientist, CMFRI, Cochin.
8.	Dr. M.M. Thomas	Scientist, CMFRI, Cochin.
9.	Shri K.J. Mathew	Junior Scientist, CMFRI, Cochin.
10.	Shri G. Radhakrishnan	Scientist 'S', CMFRI, Cochin.
11.	Shri Thankaraj Subramanian	Junior Scientist, CMFRI, Cochin.
12.	Shri T.M. Yohannan	Junior Scientist, CMFRI, Cochin.

6. Krishi Vigyan Kendra for mariculture at Narakkal*

V. BALAKRISHNAN, K.V. GEORGE, P. KARUNAKARAN NAIR, K.N.R. KARTHA, P.K. MARTIN THOMPSON, K.A. UNNITHAN, MOHAN AND P. RADHAKRISHNAN.

While the above courses of the Institute were essentially designed to train the Scientific and technical personnel, the Krishi Vigyan Kendra for mariculture established in 1976 at Narakkal, imparted need-based training to fish farmers/fishermen on different aspects of mariculture. During 1979, a total of 345 farmers including 116 farm women and 134 persons belonging to Scheduled Caste were trained in marine prawn culture through 17 courses. These courses were designed to meet the requirements of fish farmers in the collection, identification, sorting, and stocking of prawn seed, and intensive culture of selected species of prawns in the grow-out systems, and involved 90% off campus and 10% on campus programme. 3 training courses were conducted in Quilon District at Neendakara and Kozhikodu near Karunagappally. One Refresher Training course of 5 days duration was organised for ten of the ex-trainees, who are at present actively participating in prawn culture. Training of farm-women is an important step as many of them are now engaged in collecting prawn seed from the wild, thus utilising their spare time profitably and contributing to the economy of their families.

Besides imparting training, the Kendra took active part in the dissemination of information on prawn culture to the farmers through radio talks and discussion programmes.

7. Centre of Advanced Studies in Mariculture

The Centre of Advanced Studies in Mariculture was instituted at the Central Marine Fisheries Research Institute in June 1979. The main objective of the centre is to catalyse research and education in mariculture to make a breakthrough in fish production of the country. This objective would be accomplihsed by—

—providing adequate facilities to carry out research of excellence in mariculture;
—improving the quality of post-graduate education;

*Please also see detailed report of KVK

—making available modern facilities, equipments and latest literature;

—enhancing the competence of professional staff;

—developing linkages between the centre and other Institutions in the country and overseas;

—undertaking collaboration programmes; and

—organising seminars and workshops.

In accordance with the work plan for 1979–80, actions were taken up for recruitment of the staff sanctioned under the Centre. The syllabus for M.Sc. (Mariculture) and a draft syllabus for Ph.D. course-work were prepared. The University of Cochin instituted M.Sc. (Mariculture) under the Faculty of Marine Sciences. The syllabus for M.Sc. (Mariculture) and award of the degree are being approved.

The M.Sc. course proposed to be offered under the Centre is of two years duration under four semesters and includes subjects such as basic science; research methodology; marine biology; oceanography; physiology of marine animals; fisheries; fish and fishery biology; finfish culture; culture of crustaceans; integrated farming; fish farm engineering technology; management of mariculture farms and dissertation on selected topics. It is proposed to admit 10 students in each batch during an academic year.

A study tour, to identify Expert Consultants for short-term visit to the centre and to identify overseas laboratories where training of the Institute staff could be arranged, was undertaken by the Sub-Project Co-ordinator during October–December, 1979. Leading Fisheries laboratories and Mariculture Research Centres in Japan, U.S.A. and U.K. were visited and the programmes discussed with the Scientists of those institutes.

In retrospect, the Institute took an active role in furthering the knowledge gained by the researches carried out by it through organised institutional training and education to the research and technical personnel as well as to the farmers so as to facilitate rapid progress of marine fisheries development and production intensification. The programmes, would be further strenghtened in the ensuing years.

CONSULTANCY SERVICE

With the declaration of Exclusive Economic Zone extending to 200 miles off our coast, opportunities for the exploitation as well as development of marine fisheries of our country have considerably enhanced. Taking up the challenge, several entrepreneurs have ventured into this field, and many are evincing keen interest. These entrepreneurs, in connection with the formulation of the project proposals, are approaching this Institute for data/information on different aspects such as fishery resource. fishing grounds, species distribution, their seasonal abundance and prospects of diversification of fishing efforts into off shore/ deep sea/oceanic regimes and for the exploitation of unconventional resources. The Fishery Data Centre of the Institute in close collaboration with the different Research Divisions is assisting these entrepreneurs and supplying the necessary information. Besides the private entrepreneurs, the martitime States, and the Public sector undertakings in the country and the visiting International Agencies desirous of entering into collaboration projects with the Indian parties with the approval of the Government, were also furnished with the data on marine fisheries of the country.

One of the important activities taken up by the Institute has been the publication of a serial entitled *Marine Fisheries Information Service*" since September, 1978 and the Institute's *Newsletters*. The Marine Fisheries Information Service aids rapid dissemination of information on marine and brackish water fisheries resources and allied data available with the Institute, results of proven researches for Transfer of Technology to fish farmers and Industry and other relevant information needed for research and development efforts in the marine fisheries sectors. In 1979, this publication was issued every month providing

synoptic pictures of different fisheries and information on topical interest. The Newsletters published by the Institute have brought out the important events that have taken place in the marine fisheries sector in the country in general and the Institute in particular. These publications are consulted by a wide section involved in the exploitation, development and management of the marine fishery resources of the country.

The consultancy service is also provided to the fish farmers and entrepreneurs in coastal aquaculture, an emerging field having great scope for development in our country. During 1979, over 50 private parties contacted this Institute for technical advice on site selection, preparation of project proposals, procurement of seed and on improved technology and intensive culture of selected species of marine prawns in the coastal areas. The avai lable information and data were furnished to these parties so as to enable them to bring several hactares of fallow land under productive utilisation by prawn culture. Following the demonstration of techno-economic feasibility of opensea farming of mussels at Calicut, Vizhinjam and Madras, some entreprenuers have evinced keen interest to take up this venture. They have been provided with necessary information on the technology and major inputs required to start the enterprise. Similar serivde was also extended to those who sought advice/information on pearl culture, edible oyster culture and seaweed culture.

The Institute helped the commercial banks that have been approached by the entreprenuers for financial assistance by scrutinising the project proposals and providing necessary certification regarding the project's suitability and technical feasibility.

The consultancy service provided by the Institute to fish farmers and entreprenuers was free of any fees. However, the organised section and the industry are charged with a nominal fee for technical advice. Thus, extending the necessary advice on the basis of studies carried out on monitoring of growth of stocked prawns vis-a-vis environmental parameters prevailing in the field during the culture operations under the "Co-operative Intentive Prawn Farming Project" at Narakkal during 1978-79 an amount of Rs. 9225/- is being received as consultancy charge.

With the strengthening of the Fishery Data Centre as well as setting up of a full fledged Extension Division, the Institute envisages to enhance its activities in this field in the coming years.

LIST OF PUBLICATIONS DURING 1979

Scientific and technical papers:

1. **Alagarswami, K.** and **A.C.C. Victor,** 1979. Salinity tolerance and rate of filtration in the pearl oyster, *Pinctada fucata. J. mar. biol. Ass. India* 18 (1): 149–158 (1976).

2. **Anon. 1979.** Marine fish production in India during July to September 1978. *Mar. Fish. Infor. Serv. T & E Ser.* 5: 1–8.

3. **Anon. 1979.** Synopsis of marine prawn fishery of India for the Third quarter of 1978. *Ibid.,* 7: 1–10.

4. **Anon. 1979.** Pollution and fish mortality in Chaliyar river, Mavoor. *Ibid.,* 7: 11–12.

5. **Anon. 1979.** Trends in total marine fish production in India. *Ibid.,* 9: 7–22.

6. **Anon. 1979.** Synopsis of marine fishery of India 1978. *Ibid.,* 10: 1–16.

7. **Anon. 1979.** Marine fish production in India during January to June 1979. *Ibid.,* 11: 1–9.

8. **Anon. 1979.** Lab–to–Land programmes at the Central Marine Fisheries Research Institute. In *Proceedings of the first workshop on technology transfer in coastal aquaculture, CMFRI. Spl. Pub.* 6: 9–12.

9. **Anon. 1979.** Lab–to–Land programmes at CMFRI *Proc. first workshop*—Summary of discussions and action plans, *Ibid.,* 6: 75–96.

10. **Ali, Syed Ahamed., V. Balakrishnan, M. Kathirvel, L. Krishnan, S. Kulasekara Pandiyan,**

A. Lakshmi Narayana, P. Karunakaran Nair, M. Rajamani, P. Vedavyasa Rao and **A.R. Thirunavukarasu, 1979.** Prawn culture in Cochin. Experience paper. *Ibid.*, 6: 29–40.

11. **Balan, V., R. Reghu, K. Alagaraja** *et. al.* 1979. The Indian oil sardine. *Mar. Fish. Infor. Serv. T & E Ser.* 14: 1–13.

12. **Chennubhotla, V.S.K. 1979.** Progress of seaweed Culture. In *Proc. first workshop on technology transfer in coastal aquaculture. CMFRI Spl. Pub.* 6: 55–56.

13. **Gopinadha Pillai, C.S., M. S. Rajagopalan** and **M.A. Varghese 1979.** Preliminary report on a reconnaisance survey of the major coastal and marine ecosystems in the Gulf of Kutch. *Mar. Fish. Infor. Serv. T & E Ser.* 14: 16–20.

14. **James, P.S.B.R. 1979.** Constraints faced by the seaweed farmers and scientists. Proc. First workshop on technology transfer in coastal aquaculture—*CMFRI. Spl. Pub.*6: 57–58.

15. **James, D.B. 1979.** Studies on Indian Echinoderms–6. Redescription of two little known Holothurians with note on early juvenile of *Holothuria scabra Jeager* from the Indian seas. *J. mar. biol. Ass. India* 18 (1)- 55–61. (1976)

16. **Jacob, T., G. Venkataraman** *et al* **1979.** Malpe fishing harbour inferno–An impa–ct analysis. *Mar. Fish Infor. Serv.. T & E Ser.* 9: 1–5.

17. **Jacob, T., Dharmaraja S.K.** and **K.K.P. Panikkar.** 1979. Socio–economic implications of purse seine operations in Karanataka. *Ibid.*, 12: 1–9.

18. **Kurup N.S. 1979.** The mud bank prawn fishery of Kerala—Declining trend. *Ibid.*, 12: 12–13.

19. **Kalimuthu S.** and **Najumuddin M. 1979.** Seaweed culture in Mandapam. Proc. First workshop on

transfer of technology in coastal aquaculture, *CMFRI. Spl. Pub.* 6: 53–54.

20. **Kunju M.M. Kuriakose P.S.** and **Mathew C.V. 1979.** Mussel culture in Calicut. *Ibid.*, 6: 44–45.

21. **Murthy A.V.S., G. Subba Raju, Gopinadha Pillai C.S., V. Josanto, P. Livingston** and **R. Vasantha Kumar 1979.** On the occurrence of *Acanthaster planci* (The crown of thorns) at Minicoy atoll. *Mar. Fish. Infor. Serv. T & E Ser.* 13: 10–12.

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24. **Devarajan K., J. Sunny Nayagam** and **N.N. Pillai 1979.** Larval development of *Penaeus semisulcatus* H. de Han *Ibid.*, 28: 22–30.

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26. **Muthu M.S., N.N. Pillai** and **K.V. George 1979.** Larval development of *Metapenaeus affinis* H. Milne Edwards). *Ibid.*, 28: 40–50.

27. **Muthu, M.S., N.N. Pillai** and **K.V. George 1979.** Larval development of *Parapenaeopsis stylifera* (H. Milne Edwards). *Ibid.*, 28: 65–75.

28. **Muthu, M.S., N.N. Pillai** and **K.V. Goerge 1979.** Pattern of Penaeid larval development and generic characters of the larvae of the genera *Penaeus, Metapenaeus* and *Parapenaeopsis*. *Ibid.*, 75–85.

29. **Muthu M.S. 1979.** Specific identity of peaneid post-larvae found in brackish water areas. *Ibid.*, 28: 86–90.

30. **Mohamed, K.H., M.S. Muthu, N.N. Pillai** and **George K.V. 1979.** Larval development of *Metapenaeus monoceros* (Fabricius) *Ibid.*, 28: 50–60.

31. **Noble A.** *et. al.* **1979.** The Indian mackerel in 1978. *Mar. Fish Infor. Serv. T & E Ser.* 8: 1–11.

32. **Nagappan Nayar, K., P. Muthiah** and **M.E. Rajapandiyan 1979.** Oyster culture in Tuticorin. Proc. First worhshop in technology transfer in coastsal aquaculture. *CMFRI,. Spl. Pub.* 6: 59–65.

33. **Pillai, P.P.** and **S. Ueyanagi. 1979.** Distribution and biology of striped marlin, *Tetrapturus audax* (Philippi) taken by longline fishery in the Indian Ocean. *Bull. Far seas Res. Lab.* 16: 9–32.

33. **Pillai, P.P.** and **M. Honma. 1979.** Seasonal and areal distribution of the pelagic sharks taken by the tuna longlines in the Indian Ocean. *Ibid.*, 16: 33–49.

35. **Pillai P.P.** and **S. Ueyanagi 1979.** The Bill fish resources taken by the longline fishery in the Indian Ocean. Paper submitted at the Joint Meeting of the IPFC (Vth session) and IOFC (VIth session) at Manila. Mim. In *FAO Fish Rep.* 217: 11 (FID/R217/En).

36. **Rajagopalan M.** and **M.M. Meiyappan 1979.** Redescription of the sand shark, *Negaprion odontaspis* (Fowler) obtained from Minicoy Atoll, Lakshadweep. *J. mar biol. Ass. India.* 18 (1): 162–164 (1976).

37. **Ramachandran Nair P.V., K.J. Mathew P.P. Pillai D. Vincent** amd **K. Rengarajan 1979.** Prawn culture in Quilon. Experience paper, Proc. First workshop on technology transfer in coastal aquaculture. *CMFRI Spl. Publ.* 6- 41–43.

38. **Ramalingam J.R.,** and **M. Selvaraj. 1979.** Impact of sea weed culture on the socio-economics of farmers. *Ibid.,* 6: 56–57.

39. **Silas E.G.** and **M.S. Muthu. 1979.** Notes on a collection of Penaeid prawns from the Andamans. *J. mar. biol. Ass. India.* 18(1): 78–90 (1976).

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41. **Silas E.G., M.S. Rajagopalan** and **P. Parameswaran Pillai 1979'** Tuna Fisheries in India–Recent trends. *Ibid.,* 13: 1–10.

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45. **Sudhakara Rao G. 1979.** Larval development of *Metapenaeus brevicornis* (H. Milne Edwards) *Ibid.,* 28: 60–65.

46. **Shanmugavelu C.R., R. Sathiadas** and **S. Haja Najeemudeen. 1979.** Impact of the cyclone of November 1978 on fishing activities at Rameswaram. *Mar. Fish. Infor Serv. T & E.* Ser. 11: 9–11.

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the Indian seas and a revised key to the Indian species of *Endectyon* Topsent. *J. mar. biol. Ass.* India. 18 (1): 169–171. (1976).

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51. **Muthu M.S.** and **H. Motoh. 1979.** On a new species of *Penaeus* from North Borneo.

52. **Muthu M.S.** and **H. Motoh. 1979.** On a new species of *Metapenaeus* (Crustacea, Decapods) from Philippines.

Popular Articles:

53. **Appukuttan. K.K. 1979.** Trochus and Turbo fishery in Andamans. *Seafood. Exp. J.* 11 (1): 41–44.

54. **Lazarus S.** and **J.J. Joel. 1979.** The pelagic fisheries resources of Kanyakumari district, Tamil Nadu. *Ibid.,* 11 (5): 9–28.

55. **Natarajan P.** and **R. Thiagarajan. 1979.** Methods of shell cleaning and polishing. *Ibid.,* 1 (6): 19–26.

PUBLICATIONS ISSUED BY THE INSTITUTE

(Late 1978 through 1979)

1. Coastal aquaculture: Marine prawn culture Part I Larval development of Indian Penaeid prawns. *CMFRI, Bulletin No.* 28
2. Proceedings of the First workshop on Technology Transfer in Coastal Aquaculture. *CMFRI Special Publication No.* 6
3. *Marine Fisheries Information Service - Technical and Extension Series. Nos.* 5 to 14.
4. 'Samudriya krishikku oru Krishi Vigyana Kendram' (Malayalam) *Krishi Vigyan Patrika*—Mariculture Series No. 1.
5. 'Naran Chemmeen Krishiyil oru noothana samrambam' (Malayalam) *Ibid.,* No. 2.
6. 'Krishiyogyamaya kadal chemmeenugal' (Malayalam) *Ibid.* No. 3.
7. Chemmeen Kettu (Malayalam) *Ibid.* No. 4.
8. Krishi Vigyan Kendra—Concept of Lab-to-Land (leaflet)
9. Blending sea farming with traditional capture fisheries—Operational Research Project, Kovalam, Concept of Lab-to-Land (Leaflet)
10. Oyster Culture—Concept of Lab-to-Land (leaflet)
11. Seaweed Culture—Lab-to-Land release of technology.
12. Seaweed culture—Lab-to-Land (Tamil) Leaflet
13. Mussel Farming—Transfer of technology (Leaflet)
14. Mussel Culture—Concept of Lab-to-Land (Malayalam)

15. Lab-to-Land programmes of CMFRI (Tamil)

16. Lab-to-Land Programmes of CMFRI (Malayalam)

17. Easy methods of cooking mussels (Tamil and English) O.R.P. Leaflet.

18. Sasthriya Chemmeen Krishi (Malayalam) KVK leaflet.

19. Scheme on Pearl Culture, 1973-1978. Completion Report.

20. Centre of Advanced Studies in Mariculture—Background Information.

21. Syllabus for M.Sc. in Mariculture. Centre of Advanced Studies in Mariculture.

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11.	Shri N.N. Pillai, Junior Scientist, C M F R Institute.	Member
12.	Shri S. Rajagopalan, Senior Administrative Officer, C M F R Institute.	"
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GRIEVANCE CELL

The Grievance Cell relating to Staff of B, C and D groups and a separate cell for members belonging to A group were being reconstituted during the year based on revised instructions given by the Council.

STAFF POSITION AS ON 31—12—1979.

(Not a gradation list)

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Dr. M. Devaraj*

* On lien or deputation to other organisations.

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Dr. P.S. Kuriakose

Scientist 'S'

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Shri P. Dhandapani*
Shri D. Sivalingam
Shri M.M. Meiyappan
Shri P. Natarajan
Shri Mohammed Zafar Khan
Shri V.S. Rengaswamy
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Shri I. David Raj
Shri C.V. Mathew
Shri P. Karuppaswamy
Shri T.S. Velayudhan
Shri G. Radhakrishnan
Smt. K. Vijayalakshmi
Smt. B. Prasanna Kumari

Field Officer (T--7)

Shri S.J. Rajan
Shri C.R. Shanmughavelu
Shri P. Mojumder
Shri Syed Basheeruddin
Shri M.G. Dayanandan

Field Officer (T--6)

Shri S.S. Dan
Shri J.P. Karbhari
Shri S. Natarajan

Sr. Technical Assistant (T--4)

Shri G. Balakrishnan

Shri Varughese Philipose
Shri T. Prabhakaran Nair
Shri U.K. Sathyavan
Shri G.M. Kulkarni
Shri W. Venugopalam
Shri Srinivasarengan

Technical Assistant (T.II.3)

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Shri A.C. Sekhar
Shri P.S. Sadasiva Sarma
Shri P. Karunakaran Nair
Shri P.K. Mahadevan Pillai
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Shri C.V. Seshagiri Rao
Shri S.G. Vincent
Shri K.K. Balasubramanian
Shri P.M. Aboobacker
Shri K.V.S. Seshagiri Rao
Shri S. Kalimuthu
Shri K.N. Gopalakrishnan
Shri E.K. Raveendran
Shri S.B. Chandragathan
Shri G.C. Lokshmiah
Shri M.V. Somaraju
Shri I.P. Ebenezer
Shri C.K. Krishnan
Smt. K. Koumudhi Menon
Shri K.S. Krishnan
Shri P. Ramadoss
Smt. S. Lakshmi
Shri C.T. Rajan
Shri S. Manivasagan
Shri K.K. Kunjikoya
Shri V. Suresh
Shri K. Soman
Shri M. Shriram
Shri S.K. Balakumar
Smt. C. Nalini
Shri S. Kandasamy
Smt. Geetha Antony

Technical Assistants (T.I.3)

Shri S. Siddalingaiah
Shri R. Vasanthakumar
Shri K. Thulasidas
Shri A. Ganapathi
Shri B. Narayana Rao
Shri P. Ramalingam

Jr. Technical Assistants (T--2)

Shri J.L. Oza
Shri C. Kasinathan
Shri Joseph Xavier Rodrigo
Shri K. Ramasomayujulu
Shri K.P. Viswanathan
Shri C. Thankappan Pillai
Shri Joseph Andrews
Shri N. Jayabalan
Shri V. Selvaraj
Shri K. Dhanaraju
Shri V.A. Narayanan Kutty
Shri V. Sivaswami
Shri K. Muniyandi
Shri N. Palaniswami
Shri K. Muthiah
Shri K. Ramadoss Gandhi
Shri T. Chandrasekhara Rao
Shri K. Balachandran
Miss A. Kanagam
Shri D. Sundararajan
Shri D. Vincent
Shri J.R. Ramalingam
Shri M. Najmuddin
Shri K.B. Waghmare
Shri Y.D. Savaria
Shri G. Subramania Bhat
Shri C. Balasundaram
Shri L. Jeyasankaran
Shri L. Chidambaram
Smt. C.M. Allikunju
Shri O.M.M.J. Habeed Mohamed
Shri M. Selvaraj
Shri R. Thangavelu
Shri A. Srinivasan
Shri T.S. Balasubramanian
Shri V. Thanapathi
Shri H. Kather Batcha
Shri S. Palnichamy
Miss K. Uma Kumari
Shri Sapan Kumar Ghosh
Shri S. Subramani
Shri K. Chitti Babu
Shri S. Russel Conrad Samuel
Shri M. Manickaraja
Shri A. Deivendra Gandhi
Shri M.R. Arputha Raj

Shri Hameed Batcha

Field Assistant (T--1)

Shri T. Krishnankutty
Mrs. K.K. Valsala
Shri K. Chellappan
Shri K. Chandran
Shri Mathew Joseph
Shri M.N. Kesavan Elayathu
Shri K.K. Surendran
Miss. T.A. Omana
Shri K. Narayana
Shri C.S. Sasidharan
Shri V. Achutha Rao
Shri M. Manivasagam
Shri S. Sankaralingam
Shri P. Palani
Shri M. Chandrasekhar
Shri C. Manimaran
Shri N. Vaithinathan
Shri G. Arumugam
Shri S. Rajapackiam
Smt. P. Swarnalatha
Shri G. Srinivasan
Shri R. Somu
Shri M. Radhakrishnan
Shri M. Chellappa
Shri A. Ramakrishnan
Shri T. Dhandapani
Shri J. Krishna Babu
Shri M. Bose
Smt. V.K. Janaki
Shri V.G. Surendranathan
Shri M.P. Sivadasan
Shri J. Narayanaswami
Shri S.D. Dhuri
Shri K.T. Thomas
Shri Sailada Satya Rao
Shri A.K. Velayudhan
Shri P. Poovannan
Shri P. Venkatakrishna Rao
Shri A. Prosper
Shri C.J. Josekutty
Shri K. Srinivasagan
Shri Dalwadi Praduemen Mohanlal
Shri A. Ahamed Kamal Basha
Shri K. Shahul Hameed
Shri Shreekant Shreedhar Sugawekar
Shri H. Ramachandra
Shri S. Hanumantharaya
Shri Mascarenhas Robert
Shri C.K. Dinesh
Shri B. Sridhara
Shri G. Krishnaiah
Shri Padmasekara
Shri D. Nagaraja
Shri N. Chennappa Gowda
Shri Y.N. Venkatachala Murthy
Shri J. Bhuvaneswara Varma
Shri Ch. Ellithathayya
Shri N. Narayana
Shri R. Dias Johnny
Shri Arun Goshawant Mestry
Shri Dhukia Harsukhlal Karsambhai
Shri Bhupendra Popatlal Thumber
Shri Solanki Pravinchandra Dahyalal
Shri S. Chandrasekhar
Shri H.S. Shivanna
Shri O. Thippeswamy
Shri D.G. Jadhar
Shri Lahu Rambhou Khambadkar
Shri V.S. Gopal
Shri M. Samuel Sumithrudu
Shri T. Mohammed Iqbal
Shri S. Kemparaju
Shri R.G. Kavitkar
Shri H.S. Mahadevaswamy
Shri N. Varatharajan
Shri M.G. Sivadasan
Shri M. Abdul Nizar
Shri A. Nandakumar

Computor (T.II.3)

Shri Varughese Jacob
Shri G. Krishnankutty Nair
Shri P. Sivaraman
Shri V. Rajendran
Smt. V.P. Annam

Computor (T.I.3)

Smt. P. R. Krishnakumari Amma*
Shri A. Kanakkan

Computor (T--2)

Shri S. Haja Najumuddin
Shri C.J. Prasad
Smt. P.L. Ammini
Smt. K. Santhakumari

Punch Card Operator (T--1)

Shri K.P. George
Miss M.R. Beena
Shri M.B. Seynudeen
Shri S. Srinivasan
Miss P.T. Mani
Shri P.P. Pavithran

KRISHI VIGYAN KENDRA

Senior Training Assistant (T--6)

Shri P. Karunakaran Nair
Shri K.V. George
Shri K. Asokakumaran Unnithan
Dr. P.K. Martin Thompson

Training Assistant (T--4)

Shri K.N. Rasachandra Kartha
Shri A.N. Mohanan
Shri P. Radhakrishnan

LIBRARY

Sr. Library-cum Documentation Asst.
Shri. K. Kanagasatapathy

Sr. Library Asst.
Shri. E. Johnson

Administration & Accounts

Senior Administrative Officer
Shri S. Rajagopalan

Administrative Officer
Shri V.K. Sridhar

Accounts Officer
Shri S. Gopalakrishna Potti

Superintendents
Shri M.P. Lakshmanan
Shri A. Sethu Bhaskaran
Shri P. Aithappa Naik
Shri M. Subbiah
Shri R. Dorairaj

P.As. to the Director
Shri L. Krishnaswami
Shri K.M. Surendran

KRISHI VIGYAN KENDRA
OF
C.M.F.R.I.
NARAKKAL

Progress Report for 1979

V. BALAKRISHNAN, P. KARUNAKARAN NAIR, K.V. GEORGE, K.A. UNNITHAN, P.K. MARTIN THOMPSON, K.N.R. KARTHA, A.N. MOHANAN AND P. RADHAKRISHNAN.

Training Courses conducted during 1979:

A total of 345 farmers including 116 farm-women have been trained in scientific prawn farming. 132 farmers belonged to Scheduled Caste. Particulars regarding the number and duration of courses are given in the table, quarterwise.

Year & Quarter	No. of courses conducted					Person trained		
	1 month	15 days	19 days	5 days	Total	Men	Women	Total
1979								
Jan–Mar	–	–	5	–	5	88	31	119
Apr–Jun	–	–	4	–	4	40	42	82
Jul–Sep	1	–	–	1	2	26	3	29
Sep–Dec	–	4	2	–	6	75	40	115
	1	4	11	1	17	229	116	*345

**including 132 belonging to Scheduled Caste.*

The curriculam included collection, identification, sorting, stocking and rearing of prawn seeds of commercial importance.

Each course included 90% off-campus and 10% on campus programmes. 3 training courses were conducted in Quilon District at Neendakara and Karunagappally. This was an innovative approach in the sense that prawn culture had not been in practice in the region till then. The courses were organised as a part of the Lab-to-Land Programme.

One refresher training course of 5 days duration has also been organised for ten of the ex-trainees. Farmers completing training in the Kendra are given the essential seed collection implements such as bucket, drum and nylon net.

During the year the KVK had also been playing an active role at different levels of the Lab-to-Land Programme of CMFRI.

Follow-up/evaluation:

Regular follow-up measures were adopted to study the impact of training. The staff of KVK visited the ex-trainees and made a thorough socio-economic survey. The survey has revealed that 13.3% of the ex-trainees are engaged in scientific prawn farming, 17.1% in prawn seed industry, 5.7% supplementing the stock in traditional fields, 1.8% employed in prawn farms and 62.1% engaged otherwise.

Extension gatherings organized:

The feasibility of scientific prawn farming is further highlighted by organizing field gatherings. Two of such meetings organized at Neendakara in Quilon District were presided over by the District Collector. The functions were held in connection with the inauguration and valedictory functions respectively of the training courses conducted there. Similar meetings organized in other places were also attended by block and district level developmental agencies.

Culture of prawns in the hitherto unutilised canals in coconut groves, successfully introduced by KVK has earned wide popularity and is being adopted by local farmers.

New arrangement for financing scientific prawn culture:

Convinced by the feasibility of the scientific prawn culture methods evolved by the CMFRI, the Land Mortgage Bank has prepared a new scheme for rendering long-term loan facilities to intending farmers at a nominal rate of interest to implement and expand scientific prawn culture in the region.

Radio/Film programme:

The Films Division, while covering the activities of CMFRI, i.e. on "Technology of stocking and production of fast-growing prawns of selected varieties resulting in doubling of production" the activities of KVK have also been highlighted.

A documentary feature on KVK covering the activities of the trainees was broadcast in Farm and Home programme of Trichur Station of All India Radio. The following programmes by the staff ot KVK were also broadcast over the Trichur Station of All India radio:

1. Feasibility of prawn culture in paddy fields—a discussion programme led by Dr. V. Balakrishnan, Officer-in-Charge, KVK on 22..6..1979.

2. Prawn culture in paddy fields—by K. V. George, on 25..1..1979.

3. Elimination of predators from fish ponds—Talk by K. V. George, on 14..7..1979.

4. Scientific prawn cultivation—talk by P. Karunakaran Nair on 5..10..1979.

5. Collection of prawn seeds—an interview with Dr. V. Balakrishnan, Officer-in-Charge, KVK, on 25..11..1979.

6. Mussel culture—talk by K. V. George on 14..11..1979.

Publications:

During the year the KVK has published Krishi Vigyan Patrika, Series-3 entitled "Krishi Yogyamaya Kadal Chemmenugal"

(Marine prawns suitable for culture), series–4 entitled "Chemmeen Kettu" (Prawn filtration) in Malayalam.

Study tours/visits:

Shri K. Asokakumaran Unnithan, Senior Training Asst. (T–6) participated in the short course in "Livestock production for KVK teachers" held in the Trainers' Training Centre of NDRI, Karnal from 6..4..1979 to 5..5..1979.

A team of technical staff including Shri P. Karunakaran Nair, Dr. P. K. Martin Thompson and Shri P. Radhakrishnan visited Calicut Research Centre of CMFRI to make preliminary arrangements for organizing a training course on culture of mussels.

Areawise details of Farmers undergone training in Prawn Culture in 1979

District	Panchayat/Corpn/ Municipal Area	Farmers Trained		
		Men	Women	Total
Trichur	Irinjalakuda	1	–	1
	Pulloot	4	–	4
	Azhikodu	2	–	2
Ernakulam	Cochin Corporation	3	–	3
	Thripunithura	1	–	1
	Chellanam	1	–	1
	Kottuvally	–	2	2
	Varapuzha	3	–	3
	Alangadu	1	–	1
	Puthenvelikkara	3	–	3
	Ezhikkara	24	15	39
	Vadakkekkara	1	2	3
	N. Parur	2	–	2
	Mulavukadu	5	1	6
	Elankunnapuzha	17	19	36
	Narakkal	45	42	87
	Nayarambalam	29	18	47

District	Panchayat/Corpn/ Municipal Area	Farmers Trained		
		Men	Women	Total
	Edavanakadu	20	5	25
	Kuzhippilly	7	4	11
	Pallipuram	3	6	9
Alleppey	Manappuram	3	–	3
	Kuthiathodu	1	–	1
	Panavally	1	–	1
	Thanneermukkom	1	–	1
Quilon	Neendakara	34	2	36
	Karunagappally	15	–	15
Trainees from Other States:				
Kanyakumari (Dist. Tamil Nadu)		2	–	2
	TOTAL	229	116	345

List of Farmers undergone Training in Prawn Culture in 1979

DISTRICT/CORPORATION/MUNICIPALITY/PANCHAYAT AREAWISE DETAILS

(*Names of females indicated with**)

TRICHUR DISTRICT

Irinjalakuda

1. Ramadas K.P.

Pulloot

2. Raveendran C.K.
3. Krishnan K.K.
4. Peethambaran K.S.
5. Purushan A.S.

Azhikode

6. Mohammed C.K.
7. Mohammed E.A.

ERNAKULAM DISTRICT

Cochin

8. Kunjukhadar K.M.
9. Sebastian C.M.
10. Abraham I.V.

Tripunithura

11. Babu A.K.

Chellanam

12. Sebastian K.J.

Kottuvalli

13. Omana P.P.*
14. Jalaja K.K.*

Varapuzha

15. Antony Jose
16. Antony P.T.

Alangad

17. Gopi P.I.

Puthenvelikkara

18. Sasi A.B.

19. Bhasi P.P.
20. Satheesan P.P.

Ezhikkara

21. Alikutty K.P.
22. Ponnappan T.K.
23. Uthaman A.
24. Manmathan P.A.
25. Sasi K.A.
26. Joshy M.K.
27. Asokan N.A.
28. Gopalakrishnan K.V.
29. Janardhanan K.V.
30. Mayadasan K.A.
31. Muraleedasan K.K.
32. Radhakrishnan M.V.
33. Santhoshkumar N.A.
34. Ismel M.S.
35. Pushpan A.P.
36. Syamalan V.V.
37. Kochappan K.N.
38. Mohanan C.K.
39. Ratheesh P.K.
40. Mahesan K.N.
41. Uthaman C.A.
42. Shulapani K.A.
43. Sukumaran K.N.
44. Bijumon N.K.
45. Sathi K.K.*
46. Suruji P.K.*
47. Valsala K.K.*
48. Sheela M.K.*
49. Supriyakumari M.K.*
50. Jessy K.V.*
51. Kumari M.K.*
52. Sobha P.K.*
53. Sabeena K.J.*
54. Omana T.B.*
55. Premavally T.V.*
56. Sainu M.K.*
57. Chinnamma C.V.*
58. Lalitha M.C.*
59. Mani A.C.*

Vadakkekkara

60. Muraleedharan K.P.
61. Jalajamany K.J.*
62. Geetha N.N.*

N. Parur

63. Raju P.A.
64. Sasi A.K.

Mulavukadu

65. Mahesan P.M.
66. Purushan J.D.
67. Asokan V.K.
68. Purushothaman P.S.
69. Raveendran P.K.
70. Lalitha K.K.*

Elankunnapuzha

71. Rajan P.K.
72. Gopalan P.G.
73. Sajeev P.K.
74. Tomi K.V.
75. Vijayan M.C.
76. Gopi P.A.
77. Krishnan T.V.
78. Sajan T.R.
79. Sasidharan A.K.
80. Nicholovas I.J.
81. Paul K.J.
82. Haridasan C.V.
83. Pradeepkumar T.K.
84. Raju C.K.
85. Raju P.K.
86. Soman V.K.
87. Dalton Figerado
88. Usha K.K.*
89. Soumini T.P.*
90. Girijamony K.K.*
91. Sulochana P.A.*
92. Ponnamma K.K.*
93. Sasikala P.V.*

94. Daisy P.V.*
95. Philsy V.F.*
96. Renuka M.B.*
97. Sheela M.V.*
98. Thresya M.E.*
99. Girijamony K.K.*
100. Meena E.J.*
101. Ramani P.K.*
102. Sheela V.V.*
103. Soumini T.P.*
104. Thankamony P.K.*
105. Usha K.K.*
106. Kunjamma*

Narakkal

107. Manoharan K.K.
108. Prathapan K.P.
109. Rameshan P.M.
110. Reghu K.K.
111. Albert Apto
112. Mukundan K.K.
113. Peethambaran P.A.
114. Sasi K.R.
115. Shaji K.N.
116. Sudhakaran N.K.
117. Abdu E.M.
118. Chandran A.R.
119. Cherian V.V.
120. Devadas P.C.
121. Mohanan M.P.
122. Raju A.N.
123. Soman A.K.
124. Philip P.A.
125. Poulose P.A.
126. Rameshkumar P.K.
127. Robins P.P.
128. Sreedharan K.K.
129. Augustine T.A.
130. Babu P.M.
131. Josy Alex
132. Mani K.K.
133. Pavanan M.K.
134. Pius C.D.
135. Sivadas T.C.
136. Santhosh C.V.
137. Antony P.A.
138. Paul K.J.
139. Prasad T.K.
140. Ramachandran P.B.
141. Raju P.P.
142. Sasi P.P.
143. Jacob K.J.
144. Murali A.V.
145. Rajan P.N.
146. Rajendran K.B.
147. Sadanandan V.V.
148. Sudhan N.P.
149. Vasundaran A.K.
150. Johannan T.K.
151. Sajeevan P.M.
152. Baby Girija K.K.*
153. Padmini T.N.*
154. Rani M.A.*
155. Rosily K.P.*
156. Rema A.A.*
157. Sheela K.B.*
158. Thulasi P.K.*
159. Anitha P.N.*
160. Beena M.A.*
161. Beena V.T.*
162. Chinnamma M.O.*
163. Gilsa T.V.*
164. Kochu Thresya*
165. Keralakumari M.K.*
166. Lissy K.J.*
167. Merry P.A.*
168. Merry Helan M.A.*
169. Philo T.P.*
170. Rosy M.C.*
171. Seetha V.A.*
172. Vijaya I.K.*

133. Alphonsa M.P.*
174. Alphonsa K.V.*
175. Cicily N.R.*
176. Chithra C.K.*
177. Gracy M.A.*
178. Mani K.M.*
179. Merry Devassy*
180. Prabha K.K.*
181. Sulocnana N.K.*
182. Rajamma P.A.*
183. Rugmini C.K.*
184. Sathi K.A.*
185. Sumu E.A.*
186. Gracy P.J.*
187. Shyla P.B.*
188. Baby T.S.*
189. Prasanna O.V.*
190. Reji K.D.*
191. Syamala C.M.*
192. Sudha N.A.*
193. Sujatha N.P.*

Nayarambalam

194. Charly O.A.
195. Gireesan P.K.
196. Tomy A.O.
197. Dharmajan M.K.
198. Joshy M.R.
199. Joy M.L.
200. Thomas K.J.
201. Vijayan K.C.
202. Antony P.J.
203. Nandanan N.C.
204. Prabhan M.A.
205. Soman T.V.
206. Ambi C.V.
207. Babu C.A.
208. Janardhanan N.V.
209. Paul T.R.
210. Raju N.R.
211. Sivaraj N.G.
212. Dharmajan V.S.
213. Gopalakrishnan P.C.
214. Naishad T.A.
215. Raveendran T.B.
216. Jayaraman P.L.
217. Sivan V.B.
218. Varghese M.J.
219. Purushothaman P.V.
220. Thomas T.A.
221. Gopi N.K.
222. Lohidakshan K.K.
223. Philo C.O.*
224. Baby K.K.*
225. Sreedevi E.P.*
226. Girija A.V.*
227. Laila K.T.*
228. Mariyamma P.V.*
229. Sheela V.K.*
230. Sujatha K.P.*
231. Baby K.V.*
232. Geetha K.V.*
233. Prakasini K.C.*
234. Santha K.K.*
235. Parvathy N.C.*
236. Rejina N.P.*
237. Sarswathi C.A.*
238. Indira Devi P.K.*
239. Ayisha A.R.*
240. Manjula K.C.*

Edavanakkadu

241. Babu T.A.
242. Dasan V.V.
243. Kunjappan C.P.
244. Nadarajan V.V.
245. Shanmughan P.C.
246. Babu N.N.
247. Mohanan T.
248. Muraleedharan V.P.
249. Kunjappan M.K.
250. Asokan P.K.

251. Gigeeshkumar
252. Ravi C.S.
253. Sivarajan N.K.
254. Anandan N. C.
255. Bhasi O.N.
256. Majeed K.S.
257. Muraleedharan N.K.
258. Shivaprasad N.N.
259. Radhakrishnan N.K.
260. Balachandran N.C.
261. Madhavi Nanappan*
262. Remani N.A.*
263. Girija N.K.*
264. Pushpa N.K.*
265. Savithri N.K.*

Kuzhuppilly

266. Peethambaran S.K.
267. Karunan C.A.
268. Anandan M.G.
269. Joseph M.N.
270. Simon V.A.
271. Wilson T.A.
272. Karthikeyan V.K.
273. Pushpa T.T.*
274. Valsala P.K.*
275. Sarasu V.R.*
276. Noorjahan K.S.*

Pallippuram

277. Sasi K.V.
278. Sasi S.C.
279. Balachandran C.N.
280. Baby C.V.*
281. Valsala K.P.*
282. Thankamony T.N.*
283. Thuluva A.*
284. Suma K.P.*
285. Rema K.P.*

ALLEPPEY DISTRICT

Manappuram (Shertallai)

286. Madhavan V.
287. Nadesan N.K.
288. Sasidharan N.N.
289. Sreedharan K.A.

Panavally

290. Mohanan P.G.

Thanneermukkam

291. Haridas G.

QUILON DISTRICT

Karunagappally

292. Abdul Rasheed M.S.
293. Basheer M.
294. Chellappan P.V.
295. Chandran N.
296. George M.
297. Janardhanan P.
298. Kesavan C.K.
299. Mohammed Kunju A.
300. Nanu K.R.
301. Ravi D.
302. Ramachandran M.
303. Sasi N.
304. Shaji S.
305. Sharafudeen M.A.
306. Varghese M.

Neendakara

307. Gopalakrishnan P.
308. Mohanan S.
309. Nadarajan J.
310. Prabhan P.
311. Pankajakshan K.
312. Rajendran Pillai
313. Rajendran G.
314. Sadasivan V.
315. Sasidharan V.
316. Shanmugha Narayana Pillai M.S.
317. Sidharthan K.
318. Suseelan M.
319. Thampi P.
320. Vincent J.

321. Vikraman V.
322. Vasanthakumar V.
323. Babykuttan P.
324. Dharmaraj A.
325. Edward A.
326. George Joy M.S.
327. Jayadevan K.
328. Purushothaman P.
329. Remanan J.
330. Reghunathan Pillai V.
331. Radhakrishnan S.
332. Sukumaran K.P.
333. Sasidharan K.
334. Stephen B.K.
335. Ullas S.V.
336. Viswanathan Pillai P.
337. Vasudevan M.
338. Soman Pillai V.
339. Tripuran Pillai N.
340. Vijayan Nair B.
341. Mahilamani B.*
342. Omana K.*

TAMIL NADU

Kanyakumari District

343. Murughan V.S.
344. Thirumalaya Perumal

Addendum

345. Ambujakshan (from Varapuzha, Ernakulam Dist.)

LIST OF FARMERS UNDERGONE TRAINING IN PRAWN CULTURE DURING 1977 and 1978—DISTRICT/CORPORATION/PANCHAYAT AREA-WISE DETAILS

*(Women trainees indicated with *)*

TRICHUR DISTRICT

Irinjalakuda

1. M. J. Jose

Kodungalloor

2. R. R. Babu
3. C. K. Mohamed
4. E. A. Mohamed
5. T. K. Narayanan
6. A. K. Venu

QUILON DISTRICT

7. N. Chemmukannu

ALLEPPEY DISTRICT

Shertalai

8. K. V. Guptan
9. Kuriakose Manolil

MADURAI DISTRICT

(Tamil Nadu)

10. V. S. Palanichami
11. M. Regunathan

GOA

12. Anil V. Madgavunkar
13. Attaf Mavanami
14. A. O. Fartado

ERNAKULAM DISTRICT

Cochin Corporation

15. N. Sasikumar
16. T. V. Naveenbabu
17. T. V. Sanghu
18. T. K. Chandrasekharan
19. T. P. Suresh
20. K. A. Aravindan
21. C. K. Venukuttan
22. K. N. Devayani*
23. C. V. Simon
24. P. A. Saju
25. C. L. Joseph Jayan

Chellanam

26. M. G. Antony

Mulavukadu

27. K. Antony Peter
28. J. U. Gopi
29. V. M. Khader
30. P. T. Kunjappan
31. K. P. Joshi
32. K. G. James
33. K. C. Ravi
34. M. K. Sundararaj

Panangadu

35. V. A. Reguvaran

Mulamthuruthy

36. C. A. Girijavallabhan

Varapuzha

37. K. A. Antony

Kumbalangi

38. P. M. Antony
39. V. M. Jose

Thripunithura

40. P. M. Sugathan

Vadakkekara

41. M. K. Jayaraman
42. M. R. Rammohan
43. Sholi Jose

Kottuvalli

44. K. K. Ratheesan

Chittattukara

45. N. K. Mohanan
46. P. K. Satheesan
47. K. N. Manmadhan

Ezhikkara

48. M. K. Asokan
49. V. K. Bhaskaran
50. M. N. Sreenivasan
51. M. K. Mahesan
52. C. K. Nalinakshan
53. P. K. Peethambaran
54. V. S. Sadasivan
55. M. K. Vamadevan
56. N. A. Anirudhan
57. K. U. Muraleedharan
58. P. K. Ambujakshan
59. P. N. Gopalakrishnan
60. M. K. Ravi
61. K. M. Satheesan
62. N. V. Asokan
63. Augustin Jesudas
64. M. S. Sivan Pillai
65. K. Dinesan
66. P. K. Prahladan
67. P. A. Sukumaran
68. A. Uthaman
69. K. K. Venu
70. K. M. Varghese
71. M. V. Janardhanan
72. K. R. Raveendranathan
73. N. V. Salim
74. K. M. Thomas
75. P. L. Thankappan
76. K. P. Mary Stella*
77. M. P. Usha*
78. T. V. Damodaran
79. K. P. Mohandas
80. N. K. Nagendran
81. V. P. Shaji
82. A. Uthaman
83. K. K. Venu
84. K. P. Haridas
85. K. V. Nandakumar
86. V. M. Narayanan
87. V. B. Pradeep
88. M. K. Sadanandan
89. P. B. Ambujakshan
90. Antony Kaloor
91. N. N. Bose
92. N. K. Chandran
93. N. K. Kunjappan
94. T. M. Ramesan
95. N. S. Satheesan
96. V. R. Sivan
97. N. A. Shaji
98. N. A. Sudheer
99. N. C. Unni
100. K. V. Harichandraprasad
101. C. K. Sobha*
102. C. K. Chandran
103. A. N. Gopalakrishnan
104. K. J. James
105. P. A. Manmadhan
106. P. N. Mukundan
107. M. X. Bombi
108. K. P. John
109. K. J. Mathappan
110. K. A. Sasi
111. V. K. Soman
112. P. K. Surendran
113. N. A. Sukumaran
114. K. K. Viswanathan
115. M. K. Balan
116. K. K. Chandrasekharan
117. C. D. Parameswaran
118. C. K. Radhakrishnan
119. P. M. Sainudeen
120. T. M. Sudhan
121. V. A. Manoharan

Elamkunnapuzha

122. C. V. Udayabhanu
123. K. U. Gireesan
124. M. N. Raveendran
125. Thankappan
126. V. K. Vijayan
127. K. K. Anandakumar
128. V. V. Bhasi
129. K. K. Chandran
130. M. K. Muraleedharan
131. T. T. Augustine
132. M. K. Francis
133. V. K. Suresh

134. K. K. Karthikeyan
135. T. A. Suthan
136. V. D. Thailal
137. V. K. Sainabah*
138. K. V. Sulochana*
139. V. K. Suresh
140. M. E. Raphael
141. T. S. Sivan
142. V. K. Sugathan
143. A. A. Thampi
144. K. G. Debster
145. K. V. Shine
146. V. K. Gopi

Narakkal

147. P. P. Chandrasekharan
148. C. K. Karthikeyan
149. K. K. Reghu
150. K. K. Shaji
151. M. K. Vijayan
152. K. A. Balan
153. K. M. Dinesan
154. K. J. Paul
155. M. G. Sambooshanam
156. M. M. Sivaraman
157. V. K. Sivadas
158. P. A. Joy
159. K. K. Paulose
160. V. Park Pavid
161. P. K. Balan
162. I. C. Lazar
163. T. K. Kumaran
164. O. C. Prasad
165. K. N. Sasi
166. C. K. Sojan
167. N. K. Chandran
168. O. B. Ramesan
169. V. S. Jayaprakasan
170. M. K. Thomas
171. K. K. Tomi
172. K. V. Asokan
173. P. D. Jessy*
174. Jose Paul Puthan
175. K. K. Mani
176. M. V. Mani
177. C. V. Murali
178. N. A. Ammini*
179. C. N. Geetha*
180. C. K. Indira*
181. K. B. Jayamani*
182. P. B. Kanakamma*
183. T. S. Lilly*
184. M. K. Rajamma*
185. C. K. Sasikala*
186. P. P. Sobhana*
187. P. V. Salin*
188. M. Valsala*
189. V. Valliyamma*
190. N. K. Thankamma*
191. K. P. Anjalo*
192. N. K. Aysha*
193. E. G. Annie*
194. M. K. Aysha*
195. C. K. Chithra*
196. P. V. Doli*
197. K. C. Elsi*
198. C. K. Kartheeswari*
199. N. K. Leela*
200. P. K. Lissi*
201. M. D. Mariyamma*
202. N. P. Mahilamani*
203. K. R. Mariyamma*
204. P. N. Rethi*
205. K. E. Regi*
206. T. J. Reetha*
207. N. K. Thankam*
208. C. N. Usha*
209. P. V. George
210. C. D. Joshi
211. P. A. Joy
212. M. K. Sajeev
213. K. K. Bhasi
214. T. K. Chandran
215. O. S. Gopi
216. T. K. Prasannan
217. K. K. Ramachandran
218. M. D. Joshy
219. P. J. Unni
220. K. C. Velayudhan
221. Baby Jacob
222. Jaya Antony*
223. Juliet Antony*
229. P. K. Elsi*
225. M. K. Omana*
226. P. S. Philo*
227. A. T. Rani*
228. K. T. Reetha*
229. P. R. Ransom*
230. M. P. Sudharma*
231. N. K. Sarala*
232. M. S. Saraswathi*
233. C. K. Sarada*
234. N. K. Sunaja*
235. Thankamani Bhanu*
236. K. P. Thressia*
237. P. R. Thressiamma*
238. C. P. Vanaja*
239. P. K. Valsala*
240. P. S. Vasanthi*
241. M. K. Vimala*
242. K. P. Mani
243. N. A. Sukumaran
244. C. V. Balan
245. P. X. Sebastian
246. P. K. Sivan

Nayarambalam

247. K. V. Sukumaran
248. K. C. Sukumaran

249. K. P. Modi
250. K. C. Murali
251. J. Salan Menachery
252. C. B. Thomas
253. V. K. Paul
254. K. P. Sivaraman
255. K. S. Balachandran
256. K. K. Sudarsanan
257. K. R. Sulebha*
258. V. Sasangan
259. E. R. Mohanan
260. K. V. Damodaran
261. K. C. Devassy
262. P. A. Joseph
263. N. R. Sudhakaran
264. M. B. Jaithre*
265. K. K. Pushpavally*

Edavanakkad

266. K. M. Abdul Azeez
267. M. A. Mohammed
268. A. A. Chandran
269. A. B. Jameson
270. K. A. Alikunji Haji
271. K. T. Dinesan
272. K. M. Gafoor
273. M. A. Mohammed
274. P. M. Abdulla Kutty
275. K. J. Antony
276. V. K. Lalan
277. P. S. Sulekha*
278. K. A. Alis*
279. A. K. Santhakrishnan
280. N. D. Antoney
281. K. V. Shaji
282. N. K. Kanmari
283. N. K. Omana*
284. N. K. Shobha*
285. P. S. Valsala*
286. K. J. Anadoth
287. P. T. Sukumaran

Pallipuram

288. K. M. Krishnan
289. V. K. Pradeep
290. V. K. Pradeep
291. K. D. Ranjit

Kuzhipilli

292. Joseph Paul
293. S. P. Babu
294. K. N. Padmanabhan
295. N. M. Vijayan
296. K. K. Balan
297. K. O. Abraham
298. K. A. Sushama*

Estimated marine fish landings in India during 1979 (Figures in tonnes)

Sl. No.	Name of fish	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondicherry	Kerala	Karnataka	Goa	Maharashtra	Gujarat	Andamans	Lakshadweep	Private* trawlers	Total
1.	Elasmobranchs	244	4,331	6,994	12,393	222	6,954	2,531	1,280	12,516	4,926	88	364	—	52,843
2.	Eels	—	2	245	119	88	10	1	35	4,033	2,622	—	—	—	7,155
3.	Cat fishes	140	1,308	3,799	5,617	51	11,328	9,920	846	10,433	5,320	55	—	—	48,817
4.	*Chirocentrus*	407	1,644	976	1,839	167	1,125	258	122	1,721	1,970	45	—	—	10,274
5. a.	Oil sardine	—	—	—	1,011	—	1,16,834	33,080	3,030	16	—	—	—	—	1,53,971
b.	Lesser sardines	—	2,687	6,180	33,289	1,998	15,914	4,753	2,471	927	—	132	—	—	68,351
c.	Hilsa *ilisha*	660	9,969	78	41	—	6	10	2	1,071	231	—	—	—	12,068
d.	Other *Hilsa*	38	359	1,092	2,761	12	36	52	14	429	3,837	42	—	—	8,672
e.	*Anchoviella*	14	505	5,888	11,061	346	6,552	1,721	—	382	—	119	—	—	26,588
f.	*Thrissocles*	270	295	3,433	5,542	429	1,789	441	911	2,832	686	—	—	—	16,628
g.	Other clupeids	1,517	1,431	2,518	3,564	345	674	2,278	378	15,675	5,552	33	—	—	33,965
6. a.	*Harpodon nehereus*	1,211	449	717	1	—	1	5	9	59,667	63,984	—	—	—	1,26,044
b.	*Saurida & Saurus*	—	50	1,379	1,498	262	5,326	155	104	2,374	6	—	—	—	11,154
7.	*Hemirhamphus & Belone*	—	28	100	624	6	257	49	13	126	185	88	101	—	1,577
8.	Flying fish	—	4	71	1,599	854	—	—	1	1	—	—	16	—	2,546
9.	Perches	225	151	3,095	5,919	1,004	20,239	181	203	3,225	973	239	203	—	35,657
10.	Red mullets	—	2	426	1,448	203	127	30	—	859	8	—	27	—	3,130
11.	Polynemids	172	1,491	1,412	353	14	29	2	—	1,600	736	—	—	—	5,809
12.	Sciaenids	915	5,351	8,825	18,948	306	5,237	2,348	1,492	21,366	28,230	—	—	—	93,018
13.	Ribbon fish	291	616	6,337	21,040	129	25,718	1,193	548	10,983	4,491	3	—	—	71,349
14. a.	*Carnax*	71	326	3,185	7,022	537	12,339	1,103	1,343	2,314	510	134	58	—	28,942
b.	*Chorinemus*	67	716	444	844	27	128	59	140	416	466	—	—	—	3,307
c.	*Trachynotus*	—	—	—	182	—	—	13	—	—	—	—	—	—	195
d.	Other carangids	—	—	56	23	—	—	1	—	385	—	—	—	—	465
e.	*Coryphaena*	—	1	7	37	2	48	—	—	51	—	—	—	—	146
f.	*Elacate*	—	1	—	535	—	120	34	190	—	—	—	—	—	880
15. a.	*Leiognathus*	96	1,108	3,585	42,886	746	3,597	1,565	881	724	—	78	—	—	55,266
b.	*Gazza*	—	—	—	197	—	—	—	—	—	—	—	—	—	197
16.	*Lactarius*	—	5	945	1,323	11	253	433	291	430	783	—	—	—	4,474
17.	Pomfrets	923	10,109	2,069	877	35	1,737	250	138	14,941	9,319	29	—	—	40,427
18.	Mackerel	—	306	2,621	3,521	424	18,585	40,084	4,391	1,455	35	92	—	—	71,514
19.	Seer fish	331	2,444	5,547	5,228	105	6,275	1,645	1,101	4,027	2,682	138	24	—	29,547
20.	Tunnies	—	31	437	3,211	1	15,391	1,717	742	1,772	442	57	2,794	—	26,595
21.	*Sphyraena*	—	5	62	1,463	22	477	41	7	82	—	95	11	—	2,265
22.	*Mugil*	—	22	159	229	27	39	—	14	38	751	121	—	—	1,400
23.	*Bregmaceros*	—	—	—	—	—	—	—	—	276	362	—	—	—	638
24.	Soles	—	125	610	2,337	162	4,487	874	893	2,304	411	—	—	—	12,203
25. a.	Penaeid prawns	410	2,983	8,697	10,222	532	29,522	4,654	1,594	45,638	8,606	64	—	743	1,13,665
b.	Non-penaeid prawns	161	34	3,117	897	72	75	6	—	56,208	3,347	—	—	—	63,917
c.	Lobsters	—	—	33	340	5	26	15	6	499	211	—	—	—	1,135
d.	Crabs & other crustaceans	—	6	1,109	5,883	242	7,643	2,740	1,379	519	783	—	—	—	20,304
26.	Cephalopods	—	14	523	1,903	50	2,976	68	173	3,959	5,351	—	15	—	15,032
27.	Miscellaneous	2,581	2,899	4,655	17,181	632	8,635	12,074	646	7,052	33,496	69	233	16,097	1,06,250
	TOTAL	10,744	51,808	91,426	2,35,008	10,068	3,30,509	1,26,384	25,388	2,93,326	1,91,312	1,721	3,846	16,840	13,88,380

*Partial coverage of larger trawlers.